AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 3, No. 29. WEEKLY. | NEW YORK, JULY 17, 1880. | $3.00 per Annum. SINGLE COPIES, 6 CENTS.

COPYRIGHT, 1880, BY AMERICAN MACHINIST PUBLISHING COMPANY.

A New Mechanical Movement.

The accompanying engravings illustrate an ingenious and very efficient mechanical device, lately invented by Mr. J. D. Wright, of Worcester, Mass., for converting or transmitting motion between a driving shaft and wheel, or *vice versa*. The device in its various modifications is applicable to many different classes of machinery. It can be adapted as a silent rachet mechanism for the transmission of power and motion in one direction, while permitting freedom of action in the other, and applied to such small articles as watch keys, bit braces, lawn mowers, and other light tools and implements, as well as to the heaviest kinds of machines, such as field mowers, presses, etc., and in all positions where a motion acting on the rachet principle is desired. In other modifications it is applicable to use as a reaction brake for hoisting machinery, or other mechanism, wherein it is desirable that the counter shaft or driver should resist any tendency of motion coming from the driven mechanism to which it is geared, thus preventing any backward or forward action, except such as is imparted from the driving shaft.

The principle upon which this mechanical movement operates is the adaptation of inclined surfaces, formed on two adjacent hubs, for binding or cramping upon a parallel annular plate arranged between them, and thereby forming a wedge lock of sufficient strength to withstand the strain of the operative power when acting in one direction, while freely relieving the lock from all strains acting in the opposite direction.

The engravings Figs. 1 and 2 show the mechanism constructed as a rachet device, wherein *A* denotes the wheel or operating head, and *B* the spindle to be operated. *H* and *F* indicate the inclined surfaces on the parts *A* and *D*, which are mounted to turn loose on the spindle *B*, and are confined from endwise movement by the collar *G* and nut *C*; and *E* denotes the annular plate between the inclined surfaces, where it is free to wabble, but is retained to revolve with the spindle by means of a splint *M*. When the operator *A* is moved in one direction, a finger *K* engages the pin or lug *I*, and moves forward the port *D*, keeping the inclined surfaces parallel with each other, so that the plate slips easily between them; but, when turned in the other direction, the finger leaves the lug and the port *D* becomes retarded, when the inclines, by taking an eccentric position, clamp on to the plate and carry the spindle *B* around with the head *A*.

In Fig. 3 is shown a hoisting crab, with the new mechanical movement applied as a reaction stop to prevent the crank from flying back, or for sustaining the load at any position without a brake or dog. The detail of construction of this crab is shown in Fig. 4, and will be examined with much interest, as presenting a simple mechanism which will hold, in *either direction*, against strain coming from the winding drum, while it can be operated with perfect freedom, in *either direction*, by means of the hand crank. The load can thus be turned up to any desired position and there left hanging, or it can be run down by turning the crank back, but will not of itself run the mechanism backward.

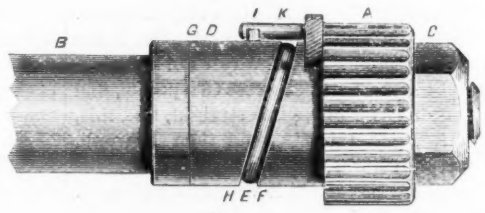


FIG. 1.

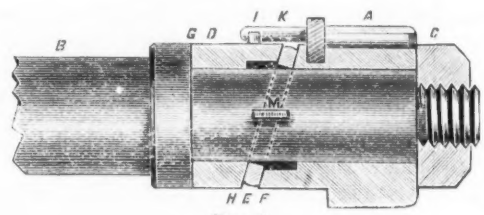


FIG. 2.

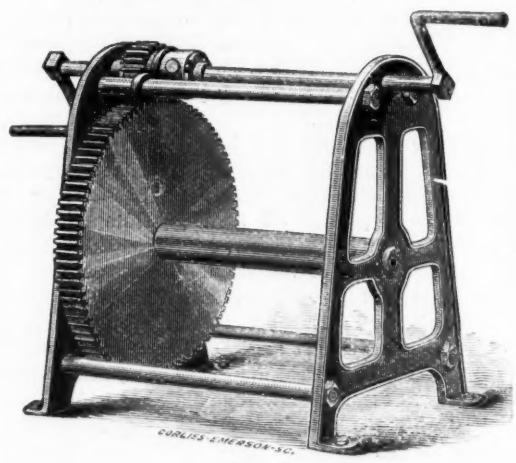


FIG. 3

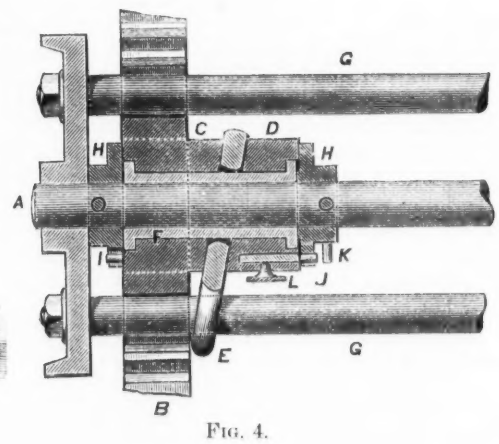


FIG. 4.

The shaft *A* is provided with flanged collars *H*, between which is a loose spool *F*, on which the pinion *C* and auxiliary hub *D* are mounted. The annular plate *E*, which passes between the inclined surfaces, is retained from revolving by connection with the frame rod *G*. The independent movement of parts *C* and *D* are limited by pins *I* and *J*, working in slots in the flanges of the hubs *H*. The pinion *C* meshes with the gear *B* of the winding drum. When the shaft *A* is turned, the ports are moved with the inclined surfaces parallel, but when the pinion *C* is started by back strain from the winding drum gear *B*, the inclines become eccentric, and lock into the non-revolvable plate *E*, and the greater the strain the more firm will be their hold. The pin *J*, by being provided with a slide *L*, can be moved outward to engage the stud *K*, and the mechanism thus be adjusted for letting the load run down by its own weight when desired.

It is obvious that this mechanical movement can be used on many other machines than those named, and in a variety of ways, which will suggest themselves to the minds of our readers who are in need of a mechanism for accomplishing the purposes for which this is intended. Messrs. Edward Wright & Co., of Worcester, Mass., are prepared to license parties, under their letters patent, to use the invention in the construction of special classes of machinery to which it is applicable.

The frequency of steamboat disasters forcibly brings to public attention the necessity of higher skill and better discipline among the officers and crews. The bravery of officers at the time of an accident will not compensate for lack of proper precautions before the accident occurs. Many of the most serious disasters on the water are caused by the parsimoniousness of steamboat owners.

Address to Graduate Engineers.

We take the following extracts from an excellent address delivered before the graduating class of the Rensselaer Polytechnic Institute, Troy, N.Y., at the Commencement a few days ago, by Francis Collingwood, C. E., Assistant Engineer on the East River Suspension Bridge and a graduate in the class of 1855:

I have chosen no special topic for discussion, as under other circumstances I might have done, but prefer rather to talk of the general subject of engineering, and principally in that aspect which leads easily to the advice I wish to give.

I would speak to you therefore of engineering as a development from our modern civilization.

The name engineer, as at present used, was first given to a builder of dykes, canals, water works and the like; then to builders of railroads, bridges, &c.; but it has come in our day to have a much broader meaning, and is applied to the scientific managers of mines, gas works, shipbuilding, mechanical operations, chemical works, sewers and drainage, agricultural works, and, perhaps, latest of all, to experts in the use of electricity.

In fact, there is a growing tendency to place all important work of every kind in the hands of engineers, so that, instead of employing scientific men to construct works and then turning them over to untaught men to manage, it is found to be altogether the most economical to pay for the best talent for their subsequent management. We may expect, therefore, that as the practical applications of science increase, so will the category of engineers be enlarged to embrace all whose profession it is to control or utilize the forces of nature, to plan and erect structures or to supervise and control the operation of any enterprise requiring scientific management.

The first engineers were men who had to work without precedent, having no knowledge of the materials they were to use or the forces to be controlled and governed, beyond that furnished by their own observation and experience.

Naturally, therefore, the successful men—the men whose names have descended to us as leaders in the profession—the men whose best works have been models and whose failures have been warnings, were men of keen insight, careful observers and experimenters, men of industry and of large administrative ability.

As the profession itself has been a development, so has there been a development in practice. The crude methods of measurement of the past, have given place to those more refined. Experiments and observations, which were sufficiently precise for the wants of the time, have been revised and newer and better results recorded, and new adaptations and uses developed. The parts of a structure, formerly proportioned by "rule of thumb," are now adjusted accurately, to meet to the best advantage the strains to which they will be subjected, with safe margins for all contingencies.

The process of refinement in measurement cannot be better illustrated than by a recently published notice of the standards used in land surveying, in the city of Providence.

The oldest deeds refer to a certain eighteen-foot pole, no longer in existence. Later deeds refer to the "Old Providence measure," which was based on two ten-foot poles as a standard. These poles were found to differ in length from each other, one inch; and in defining property under these latter deeds, a mean of the two poles has to be taken at ten feet of length. Now the standard consists of two steel bars, each ten feet long, carefully compared at a certain temperature with the government standards at Washington, and made as exact as micrometric measurement can make them.

A few years ago, rods like these, were supposed to be unchangeable in length, but now it is discovered that slow and minute molecular changes take place in metals, causing slight variations in dimension so that the standard of to-day may not with exactitude be that of a century hence, and the vexed question of standards is likely to have another field of contest, in addition to that of the meter and foot.

Let me illustrate farther this process of development. You are all familiar with the wonderful discoveries in electrical science made by Faraday; but it remained for the combined efforts of many acute minds to work out the system of delicate measurements and adjustments which has given the electrical engineer such signal triumphs as are seen in the ocean telegraph, the electric light, and the numerous other uses of electricity now so indispensable to the civilized world.

The theory of the propagation of sound by wave motion has been established for many years. It required the investigations of a Bell, a Hughes, and an Edison to develop those simple instruments, the telephone and microphone; and of a Meyer to perfect another useful instrument, not so well known, called the topophone. By the use of this little instrument, the direction from whence

a sound proceeds can be determined with certainty, even in the densest fog, and it will possibly go far toward preventing such sad calamities as that which befell the Narragansett on Friday night last.

Toricelli discovered the phenomenon called a vacuum. It is only by the perfected apparatus of the present day, however, that the internal pressure in a glass vessel can be reduced to the fraction of a millionth part of an inch, and the beautiful phenomena of repulsion among the separate atoms of air (called by Professor Crooke the fourth state of matter) made visible to the naked eye. Who knows but that some new field of engineering awaits development from this and kindred discoveries?

Take one illustration from a more professional point of view, the use of iron and steel. In the first iron bridges it was thought altogether best to use a large preponderance of cast iron. It was known that wrought iron was much the more reliable, but no one knew how to use it. Finally, by the introduction of tools of precision for drilling, facing and turning, improved forms of structure, and a better distribution of material, wrought iron entirely superseded cast iron.

Engineers, still urged on by the demand for structures of greater magnitude, in order to make them lighter, and possibly reduce their cost, began looking to the stronger material—steel—as a substitute for wrought iron. The great hindrance to its introduction was its lack of uniformity and the consequent uncertainty in strength. When the demand arose, manufacturers and chemists the world over, having learned what was required, turned their attention to the problem; and, through the efforts of such engineers as Bessemer, Siemens, our own Holley, and others, the point has been reached where with entire certainty we can use steel under strains at least one-and-a-half times as great as those which are safe for the best iron.

Experience teaches, however, that such results can only be reached by refined methods of analysis and manufacture, watching everything from the melting pot, or converter, to the finished structure. The neglect of such small matters as unequal heating or cooling, punching instead of drilling holes, or countersinking holes after dilling them, have now to be looked after, lest a sacrifice be made in ultimate strength.

All advancement in engineering knowledge and practice has been made by just such careful observation and painstaking experiment. A certain method of accomplishing a result is reached which for the time being is a finality. Then some searching mind begins to question and examine the matter; investigates it more thoroughly, makes new experiments, discovers some sources of error, a more advantageous use of material, or a new application of scientific facts, and another step forward is made.

In no profession is it more true that "we build on the labors of those who have gone before us;" and it is no less true that every success of an engineer enables him to advance to something higher, more grand, more noble, in his individual work.

What a grand future then opens before the profession, when the achievements of the past, and the rapid progress of the present are reviewed. The magnificent single span of the East River bridge, stretching 1,600 feet from pier to pier, is already threatened with a rival at the Firth of Forth, Scotland, where two such spans are projected.

The elder Roebling, the first to conceive and make practical such immense spans, shows distinctly in one of his pamphlets that a span of 3,000 feet is within the bounds of possibility, or in other words that we may yet see a suspension bridge spanning an opening of over half a mile, in a single stretch.

The Suez canal is no sooner completed and made to pay, than the greater undertaking is proposed of dividing the Isthmus of Panama, and one of the graduates of this institute, Mr. Menocal, is taking a prominent position in the enterprise.

In just so far, however, as engineering progresses towards perfection as a science, or advances in the number and magnificence of its achievements, so much the more difficult is it, for any one man to rise pre-eminent above his fellows. The number of really able men is greater than ever before, but so many great undertakings are completed every year, that they have ceased to be wonders, and it has come to be expected that a work formerly requiring a score or more of years for completion, shall now be built in two or three years.

The anxious thought and skill in planning, and the watchful care and vigilance in executing given so unceasingly by the engineer in charge are soon forgotten, but the structure into which, if he has been faithful, he has put a part of himself, remains as his monument.

Few persons appreciate the mental anxiety pertaining to the construction of any large work. The element of cost is necessarily restrictive and is frequently the controlling element in a design, the problem often being much like trying to fill a quart bottle with a pint of water.

Next is the prime consideration of safety, so that the public and all concerned may be secure against loss of life or property, all requiring diligent study and conscientious work.

After the plans are perfected is the responsibility of specifications and contracts and of seeing that the work is properly built and that no inferior workmanship or material enter into it.

Last of all is the care for the lives of the workmen under charge of the engineer, that they shall be secure from all unnecessary risk.

Such responsibility demands ready wit, scientific knowledge and thorough conscientiousness, such as fit a man for and make him worthy of success in any walk of life. It is to be hoped that the time will yet come when meritorious engineers will receive rewards more in keeping with their devotion to duty, and when inferior men will not be placed over them by influential friends, but that promotion shall be in accordance with merit.

And now, citizens of Troy, let me say a few words in behalf of the Institute.

"I speak that I do know," when I say that up to the present time its graduates have taken the first rank among men of the profession, and have been sought after in preference to those from other schools.

Not a few of your own sons have been fitted by it for lives of usefulness and honor, and the influence of its graduates has been in your manufactories, your railroads, and the improvement of your canal navigation.

It will not do, however, to rest on past laurels; the world moves so fast that he who hesitates in the race falls irrevocably behind. Other schools are fast gaining experience, receiving endownments, building up libraries and establishing physical laboratories for the study of materials used in construction, and you are in danger of losing your prestige.

The best minds are agreed in saying that theory alone cannot make an engineer, and that the profession is eminently one requiring thorough practical knowledge.

Not only should the professorships of the institute be endowed and a physical laboratory built, but the professors should have at their command such moderate funds as would enable them to obtain books, fugitive pamphlets, plans, photographs and descriptions of works in progress, and such apparatus and other helps as would enable them to teach the best practice of the day. A neighboring institution sends a photographist regularly to the East River bridge and other works in the vicinity of New York to seize upon everything, either temporary or permanent which may be of use in an engineering course, especially such details as are not found in books. The cost is comparatively little, the value great.

Whenever the time comes that an equally good course of instruction can be obtained elsewhere, the item of expense (which to many a worthy young man is of controlling consequence in selecting a school) will cause a diversion of students to more favored institutions. This can only be averted by endowments, and it rests with you to provide the funds. It is for you to complete that which is begun; so that, as in the past it has been so, this Institute may always be—a pioneer in building up the grand structure of science.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * I have on occasions been connected with the manufacture and sale of machinery, not only machinery but nice, fine, good machinery. I have talked to customers, and have tried to convince them that plain and unadorned ugliness in machinery, if it was only painted lead color, was true beauty after all. I have enlarged, to them, on the beauty resulting from an apparent adaptation of means to ends. I have demonstrated to them that this straight metal disposed exactly in the line of strain was really beautiful because it looked correct, and appropriate, and suggested capacity and fitness. And then I would explain that lines of flowing grace could not be beautiful in machine construction, because they were a violation of propriety, and a departure from the lines of self-apparent duty.

* * * * Once in a while some customer would assent to every argument advanced, and gratify me by signs of conversion. Then he would commence on me and begin to point out things and ask questions. He would probably say: "What you say is true beyond all doubt but why in the world is this monkey business in this very machine. Here is the strain point, and there is the resistance point. Now why didn't you put straight metal between those two points, and why didn't you make this straight, and this, and this, and this?" And then I would draw in my horns, and meekly answer: "Because we were afraid it wouldn't look well.

* * * * Customers have often paid me in this manner for instruction thus imparted, when my generous intention was that it should be entirely gratuitous. It has more than once been my good or ill luck to explain, for the first time, to some man the governing principles of "advanced practice."

I have explained the beauties of the straight line, and not always with the result just mentioned. I have tried to explain the propriety of putting all stiffening lumps, reinforcements, bosses, &c., on the outside of things instead of the inside, but the explanation must have fallen in soft ground to bear fruit, for I never believed in my own sermon. I have had experienced mechanics inquire about the scraping they saw, and have heard them acknowledge that they had supposed it was simply a slouchy way out of bad fitting.

In such cases I could talk with faith in my own words, and have generally succeeded in showing such purchasers that scraping was in reality a way out of bad fitting, but that its presence would indicate that the suspected bad fitting had been the best known to the art, and that the defects were not allowed to pass; that the scraping indicated a cognizance and correction of faults bound to exist in the best of fitting.

Then questions would be asked on the subject of the lead colored paint, and in reply I would advance the straight metal argument over again. Sometimes a customer would come down with some such talk as this: "As near as I get at your meaning, you put straight lines in metal because that is the strongest form; because if the lines were curved for looks more iron would be used, and so the machine would cost more. All I can get out of your paint talk is, that it is cheaper. In short, your whole aim in these two matters seems to be to get things down cheap. Now, the fact is, that your price seems high enough to cover everything, time, utility, ample strength, and unlimited beauty in design and paint. You tell me that the character of workmanship indicated by this careful scraping of sliding surfaces is carried throughout the machines, and that this character of workmanship, compared with ordinary work, is enormously expensive. These are the only conclusions I can draw from your arguments, and I wonder at your not starting out with the statement that your work was done so well and cost so much that I could not afford to buy it, if you had not left off every unessential detail."

* * * * Again, I would talk nicely of the system of work by which we secured a uniformity of excellence, a duplication of parts, interchangeability, and all that. Then maybe I would try and show up jigs and templates and special tools of every description, and would show the means by which we could keep all similar pieces perfectly uniform, and I would explain how a customer could at any time order a new part to replace a damaged one, and he could feel assured that it would fit exactly in place. And then some smart customer would say: "Do you believe any of that yourself?"

* * * * This was long ago; the customer has bought his machinery somewhere or else he has not, and I have none to sell, so I don't mind saying that I don't believe a word of that stuff. I got off on interchangeability.

* * * * Small work, such as watch work, clock work, gun and pistol work, sewing machines, etc., are in substance, and in fact, made interchangeable, and furthermore the work is done perfectly. The allowed variation in size of parts may be put at the half a thousandth of an inch. Any piece taken from a car load of parts will fit perfectly its place in connection with any other piece. This interchangeability is bound to result from the system of manufacture. The test of each individual piece is by limit gauge, and if there were to be but one piece the same system of gauging and inspection would be used. The fitting is a result of the relation of gauges. The parts of such work are small and the fitting surfaces are small. Bringing these small surfaces to gauge is reduced to a trifle in the way of time and money. These articles are sold in immense numbers, and justify the expense of the systems of manufacture involved, and the very systems of manufacture insure the perfection of the article; insure the low selling price of the article, and insure the large sale of the article which, by a system of rotative insurance, insures a good return for investment in means and systems of construction.

* * * * From watch and sewing machine work we jump to mowing machines. Here we have duplication or interchageability as absolute as any found in sewing machines. In sewing machines and guns, extra parts will fit and will fit right, and in mowers and reapers extra parts will fit and will fit right. But fitting right is one thing in one and another thing in the other. In sewing machines, etc., the variation is limited to the half thousandth of an inch in shake and in position.

Seats for permanently-fixed pieces are cut and limited in variation. Carry this plan to the reaper and cradles would do the reaping. In the reaper, the limit of shake is several thousandth, at least. The limit of variation in position is about an eighth of an inch. Surfaces for fixed joints are uncut. Fits are larger and correction slow and expensive, but their number is kept as small as possible. In sewing machines, the parts while highly-wrought all over, are inexpensive, and in economical systems of manufacture, may well involve the wastage of parts showing the least defect. In the reaper, the parts are heavy, but have but little cut surface, little expensive work on them. When finished they are material in a third state. They are not expensive, and an economical system may well involve the recasting of parts showing the slightest defects. The reaper and its kindred, like the sewing machine, is sold in vast numbers, and here again we have the rotary insurance justifying investment, perfecting the product, and giving the world a low price list.

* * * * The sewing machine and the reaper are, or should be, perfectly made articles. They should be interchangeable. The profits of production should be enormous, and the market price should be so low as to be a blessing to man. I believe all these conditions are fulfilled in fact.

* * * * Between the classes of machines I have named we must place the locomotives, stationary engines, machine tools, wood-working machines, &c.

Can they be made interchangeable, or rather can they be sold if made so? Such work as this has the accurate fit of the gun lock, the cut seating of the sewing machine, the cut surface of the watch movement, and forty times the mass of the reaper.

* * * * The expense of the systems of specials and gaugers required in sewing machines and such like work is enormous, but as before stated, it is amply justified.

The Providence Tool Co. got a contract for a lot of rifles. This concern was big in every way. They had made guns and had lots of gun-making machinery, and could probably have worried out their contract if they had had a lifetime to do it in. But it was important that money should be made on this contract as it was that the guns should be made.

The contract called for a perfect gun at a low price, and business called for a profit. If there is enough of things to make, this principle is all right, and the whole thing is settled by simply putting money into the processes. I have been informed that before the Providence Tool Co. made a gun on this contract they expended a million dollars in appliances. There may be a discount on the statement, but there is none on the appliances. I examined with considerable care and interest the master gauges constructed for this gun. I don't know how much they cost, but twenty thousand dollars is way below the figure. Furthermore, it is reasonable to suppose that they didn't spend any more money on them than their judgment and experience told them was requisite. So much for the gun with its lightness, and its smallness of parts, and smallness of cut surfaces, and its manufacture by the hundred thousand.

* * * * Transform the gun into a lathe. Increase the area of cut surfaces three thousand times; decrease the accuracy of fit twenty-five per cent.; increase the weight of parts five hundred times; and change the number contracted for, from half a million to, say, two hundred.

* * * * Master gauges for a fifteen-inch lathe would cost not a cent less than a quarter of a million of dollars if the gun plan was carried out. Special machines would cost millions more, and a shop to hold the set of machines to make one size of lathe would fill a county.

This is what would become of such a plan: If gun-like provision was made for building lathes at a low price while securing perfect work, the interest on the investment would raise the price to a thousand per cent. increase over the present price. In short, if done in the cheap way the product would cost too much money. Again, if the accuracy and interchangeabilty of the gun is put on the lathe without the gun-like provisions for it, the cost of the skilled labor would increase the present price a thousand per cent.

* * * * Now the real fact is that the lathe is the staple machine tool. There are more sold than of any other machine tool, and the lathe may be taken as a type of marketable class, including steam engines, wood tools, printing presses, &c., &c. Machine tool builders with a good trade build lathes in lots of from twenty-five to fifty at a time. Invention puts a new kink in every tenth lot. This of itself would knock the gauge business. Furthermore, the lathe represents one machine in a list of say fifty machines built in the same shop. No market will justify the cost of gun systems in the construction of such machinery. In gun work, &c., the interchangeability don't cost anything. It is simply a consequence and a result of the maintainance of a standard of excellence and economy. The market requires the interchangeability in such work, and the shop makes money by furnishing it.

The man who builds nicely-fitted, heavy machinery, don't make by interchangeability if he could secure it. He don't want to keep the run of discarded patterns and forms and tools, etc. Many builders of such machinery proclaim that their work is interchangeable; but it's a sham. There is no concern in the world which can furnish a fifty pound piece of nice steam-engine or machine tool work, with six holes, or notches, or grooves, or rabbits in it which will fit in the place of a predecessor, made three years ago. All such work, is in fact, fitted to its individual place, and no other piece will fit them till it has been worked up to suit its location. This assertion is made with a fair knowledge of the finest, heavy machine done in the United States. In England they are far ahead of us in applying special machinery to very heavy work, but they don't make nice, heavy work interchangeable.

If nice, heavy machinery is represented as interchangeable, one may be sure that the statement is false, or that the market cannot pay one-twentieth of the cost.

* * * * Notwithstanding all this, the good shops in our country to-day, in view of the tools, skill and systems, justified by business policy, have no excuse for not being able to send out extra parts which *can be easily fitted to place.*

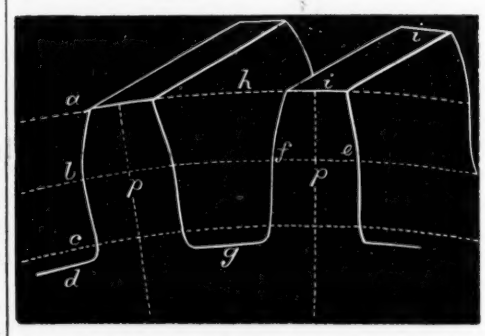
* * * * Very respectfully,

CHORDAL.

Practical Draughting—Gearing.

BY T. P. PEMBERTON.

The term gearing has various significations, and is extensively applied to different kinds of manufactures. For instance, we speak of the harness or tackle of beasts of burden, as their gear; of purchases or tackles on board a ship, as the gear. In steam-engine machinery we find certain parts spoken of and known as the valve gear, expansion gear, etc. But the term is most extensively applied to those parts of machinery where motion is communicated from one axis to another, by means of cog or tooth wheels, or even by friction rollers.



Hence the term *spur gearing*, in which the teeth or cogs are placed round either the convex or concave surface of a cylindrical wheel, in the direction of radii from the center of the wheel; *beveled gearing*, in which the teeth are placed on the exterior periphery of a conical wheel, in a direction converging to the apex of a cone, and the depth of tooth gradually diminished from the base; *frictional gearing*, by which motion is communicated from one shaft to another, by pressing into contact two cylindrical or conical rollers with smooth or corrugated surfaces.

Before undertaking to draw out spur and bevel wheels, the student must become familiar with certain technical terms and definitions that are inseparably connected with the delineation and subject of gearing. A *cog wheel* is the general name for any wheel which has a number of cogs or teeth placed round its circumference. When the teeth of a wheel are made of the same material and formed of the same piece as the body of the wheel, they are called *teeth;* when they are made of wood or some other material, and fixed to the circumference of the wheel, they are called *cogs*. A *pinion* is a small wheel. When two toothed wheels act upon one another, the smallest is generally called the pinion. The terms *trundle*, and *lantern* are applied to small wheels having cylindrical bars instead of teeth. We speak of *trundle wheels, lantern wheels.*

The teeth in pinions are sometimes termed leaves; in a trundle, *staves.*

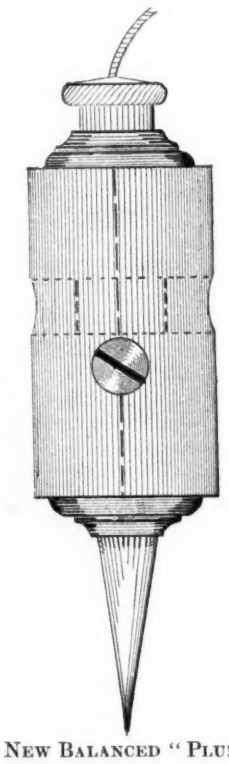
The wheel which acts is called a *leader*, or *driver*; and the wheel which is acted upon by the former is called a *follower*, or the *driven*. When a screw, or *worm* revolves in the teeth of a wheel, the latter is termed a *worm wheel*, or *worm gear*. When a pinion acts with a rack having teeth, we speak of *rack* and *pinion*. When the teeth are on the inside of the rim, and not on the periphery, the wheel is termed an *internal gear*. A *crown wheel* has its cogs or teeth at right angles to its plane.

Two wheels acting upon one another in the same plane are called *spur gear*; the teeth are parallel with the axis. When wheels act at an angle, they are called *bevel gear*. *Miter wheels*, are bevel wheels of the same size, working at right angles with one another angle of teeth 45°.

There is a variety of gear wheels, as, for instance, plate wheels, which have solid bodies, and arm wheels that have three, four, six, or more arms between the hub and the rim.

We now refer to the annexed diagram; that is a perspective view of two adjacent teeth on the periphery of a spur wheel. We call attention to this simple representation as preparatory to drawing out a spur wheel.

The "periphery" of a wheel is the extreme circumference. The "pitch line" or "pitch circle", is supposed to be the working circle. The working circles of two spur wheels "in gear" would be represented by two circles tangent to each other. The pitch line is a most important one in gearing. The diameter of both spur and bevel wheels is measured and calculated neither from the outside nor from the bottom of the teeth, but on the pitch circle. When we speak of the diameter of a spur or bevel wheel, we mean the diameter of the pitch circle, without any reference to the form of tooth. It is on this circle that the centers of the teeth are spaced off. The diagram may be referred to as an illustration:—*a* is the periphery; *b*, the pitch line; *c*, the working depth; *d*, the root of the tooth or cog; *e, f*, the thickness; *g, h*, the whole length; *i, i*, the breadth of each tooth; *p, p*, the pitch of the teeth, that is, from the center of one tooth to the center of the next on the pitch circle.



A NEW BALANCED "PLUMB-BOB."

Commencing at the center, a spur wheel may be said to consist of a hole, square, octagonal or round, for its axle or shaft; a hub; the web, body or arms; a rim, and the teeth. The fundamental circle is the pitch circle on which the teeth or cogs are set out by the draughtsman and the pattern-maker, and by the diameter of which, or the number of teeth on it, computations relative to proposition, speed and strength a

---

The *Miller* (London) says: Mr. Vincent Till, of the Flour Mills, Bruck-on-the-Mur, Austria, a member of the Austrian Millers' Association, has issued a prospectus of his training school for millers. The mill is working with grooved and smooth chilled iron rollers, porcelain rollers and millstones. There are also five systems of flour dressing machines, and three systems of middlings purifiers at work, so that every opportunity is afforded for judging the relative merits of the various machines. A bakery and flour testing establishment is attached to the mill, where experiments can be carried on. The volunteers who wish to enter the mill must pay a premium of £25 as entrance fee, but they will be permitted to make copies or sketches of anything they may wish for their own use. Each volunteer must provide for his own board and lodging, the terms for which are very reasonable. Theoretical instruction as well as practical will also be provided. The *Walzenmuller* recently informed its readers that it could furnish them with the name of a mill where volunteers would be received on similar terms to the above, and within a few days the editor received more than sixty applications.

A New Balanced "Plumb-Bob."

BY A. FORREST.

Every mechanic, at the expiration of his apprenticeship, should have formed in his mind a scale ranging from absolute perfection to a point, so to speak, somewhere in the latitude of inadmissibility, and on this scale should fix his limit of inaccuracy, by which to be governed in all future operations. Whether mechanics, generally recognize the fact or not, there is such a scale, and observation proves that the mechanics who have marked the point of extreme departure from accuracy the nearest to the *zero line*, are those who accomplish the most in a given time. The mechanic who observes the closest rule of correctness, one who would exhibit the correctness of the mechanic as much in making a wood-box for his own kitchen, as in making an organ case for his neighbor's parlor, is the one who will make a greater number of either wood-boxes or organ cases in a given time, than any two lightning botches living. To the painstaking mechanic, the world owes much, while the lightning workman, whose passable jobs are accidents, is a curse to every thing he comes in contact with in his line. This is a long preface to a simple "plumb-bob," but it has a moral in it, nevertheless.

The universal demand for better workmanship, creates a demand for more accurate implements and tools in the hands of the workman, and the day has gone by when manufacturing establishments seek for workmen whose tool boxes contain nothing superior to a pair of pot metal calipers and a No. 16 square; hence we see implements of accuracy coming into the market every day, and I will pick out from amongst the workmen of any shop, the good and the poor mechanics, simply by noting the interest they take in the sample case, where such tools are exhibited.

The object of this writing is to present to such mechanics as employ the device in their business, a new plumb-bob, made for accurate adjustment. The article is not patented, and may be made and used by any one who wishes. In setting up machinery, especially in mills, it is often necessary to erect an exact perpendicular line from a fixed point on the floor. This cannot be done readily, if the plumb-bob used is not so balanced that the long, sharp point hangs in an exact line with the line by which it is suspended, as all mechanics will understand, and when, by the untwisting of the line, the point is caused to gyrate to any extent, the operation is next to impossible. To obviate all the imperfections in making this useful article, I have constructed a plumb-bob, with balance weights inserted, as plainly shown in the cut herewith. These weights are shorter than the disc of the body of the plumb-bob, and threaded to fit the internal threads of the holes. A "nick" for the screw driver is cut across each end of the weights, by which they may be moved out or in at will, thus admitting of the "bob" being so balanced that the point will hang in an exact perpendicular line with the string by which it is suspended.

Working Drawings of a Steam Engine. Elevation of Cylinder.

The accompanying engraving represents the outside view of a cylinder of W. H. Hoffman's 100 Horse Power stationary steam engine. The construction of this cylinder was illustrated by similar engravings in the AMERICAN MACHINIST for Jan. 3 and 10, 1880. Full details were given in the latter number which refer directly to the illustration shown in this issue.

Keying up Locomotive Side and Main Rods.

BY FRANK C. SMITH, M. E. (V. HOOK.)

When it is necesary to key up a main rod the first thing to do is to take it down, after placing the engine on the center on that side. It would be well to ascertain now if the travel slots in the guides are correctly located. These slots are for the purpose of preventing the cross-head from forming a shoulder on the guides, and they do this by the cross-head traveling half the width of the slot past its inside edge, if the rod is of the right length. Their province is not as many engineers think, to lead off the oil forced to the end of the guides by the cross-head. To ascertain if they are correctly located, pinch the cross-head to each end of the guides, after the main rod is down till the piston-head strikes the cylinder-head. Then make a mark even with the end of the cross-head on the guides. If these marks are equally distant from the travel slots, they (the slots) are correctly located and can thereafter be used to key the length of the rod too. The rod being down, the pins should be calipered across their horizontal diameter when the engine is on the center, because the pin wears smaller across its horizontal diameter when it is on the top or bottom quarter, as the piston's pressure is most effective on the pins at this point; and if the boxes were reduced to this diameter they would evidently bind when on the pin's greater diameter; that is, when on the center. If the pins are much out of round they should be corrected with a file. Having calipered the pins as above, take this diameter in a pair of inside calipers. Lay the boxes "brass and brass" and by the inside calipers ascertain how much must come off to allow them to bear on the pin, remembering to take half the amount as indicated by the inside calipers from each brass. Having filed off what is necessary from the boxes, place them in the strap on the pin and drive the key till the boxes are "brass and brass." Then if they can be revolved easily by hand on the pin they are right.

They should not, however, be filed so as to allow of their standing apart when keyed up, but should touch each other. The key may now be slacked back, the brasses shifted to the open end of the strap, and a piece of stiff putty placed on the inside crown of the strap, and the key driven till the joint of the brasses stands in line with the center of the oil hole in the strap. The key should be marked even with the strap, and the strap and boxes disconnected from the pin. The thickness of the putty will indicate the thickness of the liners necessary to be put in. When the joint of the brasses is in line with center of oil hole the length of the rod should be right if the rod is made right.

Perform the same operation on each end of the rod; put it up and drive the keys to the marks made on them, and then try the length of the rod by pinching the engine past the centers, when, if the cross-head travels an equal distance past the edges of the travel slots in the guides, the rod is of the correct length. If not, its length should be altered (by inserting or taking out liners as the case may be) till correct when tested by the travel slots, if they are correct.

It is obvious that the rod must be just right when keyed by this plan. The brasses should always be "brass and brass" as they will run much longer. After taking down the side rods, the wheel centers should be trammed and equalized by the wedges, if they are not correct. The wedges should be up snug when keying the side rods. If there is much lost motion in the side rods the back pins will be found to be behind when the tram is placed on the pin centers. They should, therefore, be slipped till the tram will drop into the pin centers. This can best be effected by taking the weight off from the back wheels with a couple of jacks under the foot-board. The boxes may be reduced to the pins as for the main rod leaving them "brass and brass."

The front end of rod may be put up, the joint line of brasses coinciding with center of oil hole in strap as for main rod. Then put up the back end, shifting the boxes in the strap with the two keys in the back end till the rod can be shaken with both hands. This plan first reduces the brasses to the pin, leaving them loose enough when keyed, "brass and brass."

The front end is put up with liners forward of the forward box, till the boxes coincide with center of oil hole in the strap, and the back end is put up and adjusted by the two back keys till the rod can be shaken.

The engineer knows, therefore, that the boxes themselves are not tight on the pins, and as the rod is loose enough to be shaken, it is proven that the keys have not been driven so as to tend to force apart or draw together the pins, hence the rod is right.

Another plan much in use after filing the boxes is to drive the forward key which forces the back box of the front end to the pin. Continued driving of the same key forces the rod back which draws the front brass of the front end up to the pin, and also forces the front box of the back end to its pin, the back key of back end being then driven to force the back brass of back end to the pin. The back key goes down twice as fast as the other keys, as it has not only its own lost motion to take up, but that also of the forward boxes which is thrown upon it when the whole rod goes back.

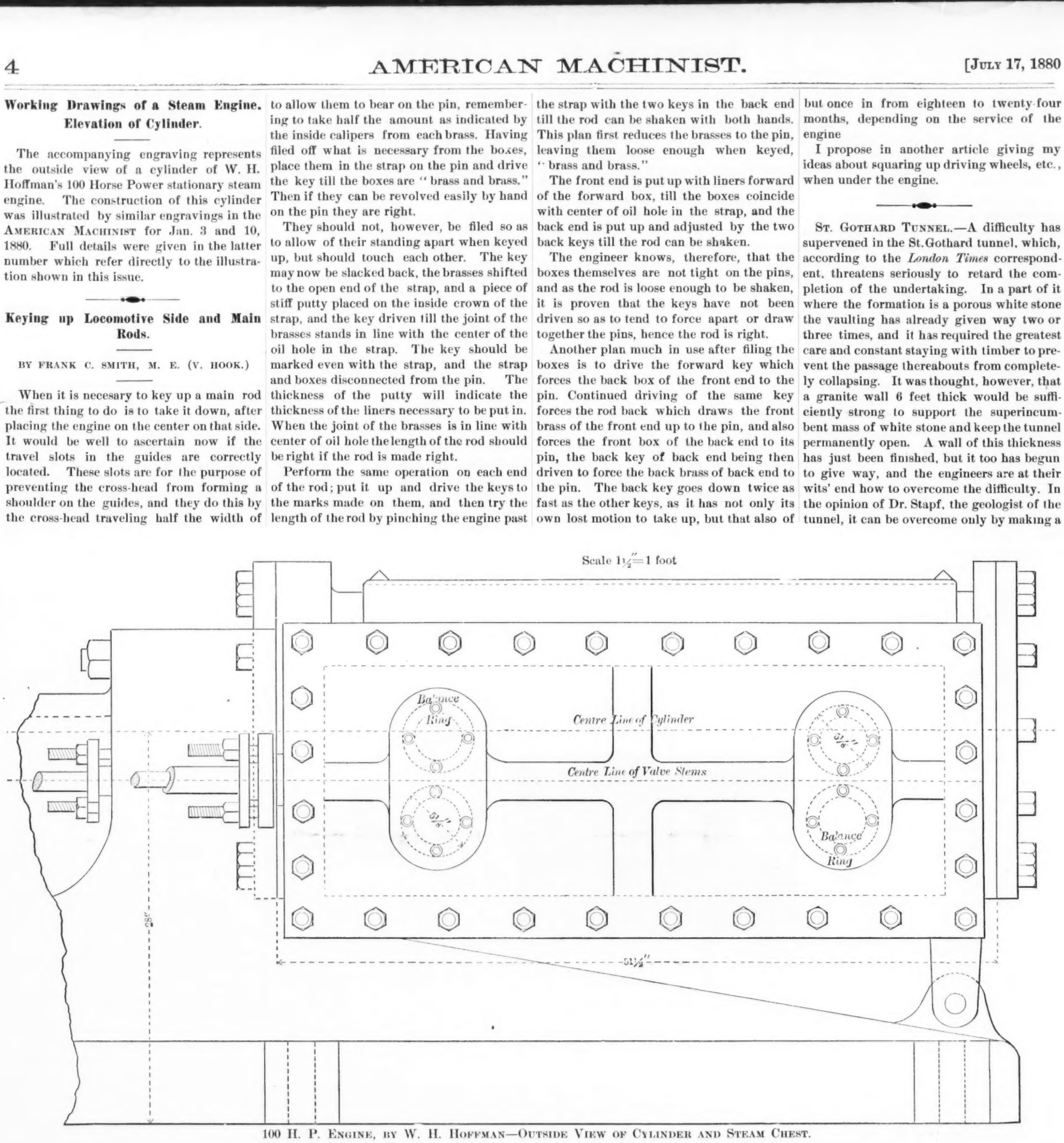
The writer assumes that the side rod has three keys, two between the pins and one back, and that the main rod has two keys between the pins. When the side rod has four keys the forward key of front end takes the place of the liners.

Side rods on switching engines and on road engines, if the track is rough, should be run loose, as the driving boxes shift up and down in the jaws to a greater extent than other wire, and as this changes the distance between the pins, the loose side rods accommodate this change.

In ten-wheelers, the side rods should be keyed from the front end back and not, as is sometimes the case, the other way, or partly back and partly forward.

In the plan given for keying side and main rods, it is necessary to take the rod down each time it is keyed, as the plan leaves the brasses "brass and brass." This is the better plan, as the boxes then have all of the advantages of a solid box, together with that of adjustment. The writer remembers a case in which the engineer, adhering rigidly to the "brass and brass" plan, did not find it necessary to touch his side rods but once in from eighteen to twenty-four months, depending on the service of the engine

I propose in another article giving my ideas about squaring up driving wheels, etc., when under the engine.



100 H. P. ENGINE, BY W. H. HOFFMAN—OUTSIDE VIEW OF CYLINDER AND STEAM CHEST.

ST. GOTHARD TUNNEL.—A difficulty has supervened in the St. Gothard tunnel, which, according to the *London Times* correspondent, threatens seriously to retard the completion of the undertaking. In a part of it where the formation is a porous white stone the vaulting has already given way two or three times, and it has required the greatest care and constant staying with timber to prevent the passage thereabouts from completely collapsing. It was thought, however, that a granite wall 6 feet thick would be sufficiently strong to support the superincumbent mass of white stone and keep the tunnel permanently open. A wall of this thickness has just been finished, but it too has begun to give way, and the engineers are at their wits' end how to overcome the difficulty. In the opinion of Dr. Stapf, the geologist of the tunnel, it can be overcome only by making a wide curve so as to get round the white stone instead of going through it. This would involve the entire reconstruction of that part of the tunnel, in which case it will probably not be ready for traffic before the time fixed for the completion of the lines of approach, two years hence.

ROYAL CORNWALL POLYTECHNIC SOCIETY.—This society, which we regret has no imitators in other parts of the country, will hold its 48th annual exhibition at Falmouth on August 31st., says *Design and Work* of London. Medals and prizes will be given for useful inventions and improvements in the several departments. In addition to the Society's usual prizes, several premiums will also be awarded. Amongst other things (1) Improvements in pump valves, (2) Improved machines for dressing ores, (3) Collections of ores, (4) Improved treatment of ores and minerals, (5) Economizing fuel and ventilating buildings, and (6) Improved methods of making casement windows weather-tight We have by no means exhausted the list, for numerous other premiums will be given to experts, apprentices, and amateurs, in the various branches of the arts and sciences.

Management of Marine Engines—Getting Under Way, Accidents, &c.

BY ALFRED R. WOLFF, M. E.

The following are some of the precautions which should be observed when *getting under way.*

See that the drain valves to main steam pipe and cylinder are open.

Open stop valve on boiler slowly and warm cylinders by admitting steam to top and bottom.

Before moving the machinery report to the officer of the deck, so as to prevent accident by getting ropes that may be hanging from the vessel twisted about the propeller, or injuring boats made fast to the stern of the ship.

Give timely notice to the firemen and oilers to stand clear, and work all the greasy water out of the air-pump and condenser before putting on the feed pumps.

Start the feed pumps while the engines are moving slowly.

The drain-valve on the main steam-pipe should be closed as soon as the pipe is fully warmed and free from water, and the drain valves of the cylinders should be partially closed (after having been blown through and cylinders warm) so as to prevent too great an escape of steam.

When first put in motion the engines should always be allowed to pass the centers slowly so as to prevent accidents from water in the cylinders.

When coming into port attention should be paid to the following points. The engineer should be properly notified about half an hour before coming to anchor or dock. This will secure economy of fuel, enabling the engineer to regulate his fires so as not to be obliged to blow off steam by raising the safety valve, and to have a proper amount of water in the boiler on stopping. When thus notified he orders "to fire lightly," just sufficient to retain the pressure, or let it fall slightly and pumps a little more water into the boiler. A few minutes before reaching the anchorage he stops firing altogether, and when he then gets the bell to stop, his fires are light, ready for being easily banked, the pressure of steam is lower than the ordinary working pressure and no steam is lost by "blowing off." This "blowing off" of steam is a positive waste and nuisance which can be obviated if the deck officer will only notify the engineer of the watch as indicated above. Of course, there are occasionally exceptions to this rule where steamers, while entering a crowded harbor, require a proper head of steam to facilitate the rapid handling and steering of the vessel, but even in the worst cases a high pressure of steam can with proper care be kept up with light fires and blowing off steam prevented. When under banked fires the pressure of steam is usually kept at much less than the ordinary working pressure, and it is well to shove in the weight of the safety valve so that it will blow off steam when the lower pressure is exceeded. This will prevent careless firing and inattention on the part of the firemen when the engineer is no longer in the engine room.

Saturated steam at high pressure is a good lubricant, and therefore the high-pressure cylinder of a compound engine actually needs but comparatively little oil. However, a self-lubricating oil cup is usually applied to the high-pressure cylinder, with the idea that the oil will mix with the steam and will be carried over into the low-pressure cylinder as well. When the steam is greatly expanded, and thus decreased in pressure and water of condensation formed, the low-pressure cylinder will often become "dry" and begin to "grunt" and "wear"; it will therefore be better, besides having the ordinary oil cup at the top of the low-pressure cylinder, to have a self-lubricating cup attached to it as well. Sometimes owing to a miscalculation or leak, the oil runs short; in such a case lard oil mixed with lime-water—even in the proportions of one gallon of oil to every three or four gallons of lime-water, will be found a fair lubricant for bearings. For cylinders this will not answer. As a whole lard oil possesses the greatest number of good qualities of any particular oil, for it answers well in cylinders and for bearings, and burns readily giving a fair light.

As far as accidents are concerned, no general directions of specific value can be given but it is a good plan for the engineer to consider all possible accidents to the particular machinery under his charge and their remedies. The writer knew of one engineer—a valuable man on this account—to whom it was difficult to mention any probable accident of which he had not thought beforehand, and for which he could not at once suggest the most feasible remedy. And this is a necessary knowledge too, for confusion and loss of precious time is thus saved in case of "accident." When in fine weather the vessel and engine are moving along pleasantly and everything is in good order, this exercise of considering the most practicable remedies for possible "break-downs" will form an agreeable and profitable occupation for the mind, since reading is usually not and should *never* be allowed while on watch at sea.

The management of a marine engine involves the management of men as well—firemen, coal-passers and others, and not a little does the successful operation of the machinery depend upon the proper relation which exists between the engineer and his inferior in rank. While the engineer should always treat them as men, with due kindness and respect, he should maintain a proper dignity, not being supercilious towards them, but bearing himself so as to deserve the respect and politeness which he should insist upon. In the line of duty, familiarity and favoritism should be carefully avoided, for misunderstandings, discords and disobedience are the ordinary consequences. The engineer should always evince interest in his men, and if they are in search of knowledge aid them to his best ability, and induce them to think for themselves and study, if possible. He will find himself well repaid for his trouble, for he will not only acquire many practical points of interest—for they are usually men of considerable experience and some power of observation—but they will be scrupulously careful to promote his interest—the efficiency of the machinery in every possible way.

The most ignorant men know when they have a good superior, and judge this quality not only by his ability, but by the treatment they receive. This is a "point" which is ignored to a great extent, to the disadvantage of all concerned.

Much as successful management depends upon the relation to the inferiors, the engineer's relation to his superiors deserves the same consideration. There is usually a silly feeling of jealousy between the engineer and deck corps of a vessel, and such stories as "throwing monkey wrenches at the heads of commanding officers" are too common, though occasionally if not more frequently, exaggerated. They ordinarily amount to having the "oiler" oil near where the commanding officer is sitting in the engine room, and "accidentally" (on purpose) spill oil on his clothes or stumble over his legs, and occasion other similar annoyances. Still, this jealousy does exist where there should be a feeling only of unanimity and united interest. It is impossible to see clearly where the interests conflict, except in petty points of rank. A commanding officer is responsible for the safety and decorum of a vessel as a whole, and should have control of all his officers and men in this particular; for the engine the chief engineer, by virtue of his position and his training, is alone responsible, and he should have absolute control in this department subject to no interference whatever as far as the care and management of the engine itself is concerned. If these two facts are properly appreciated and acted upon there will be less bad feeling. There can be no doubt that under the present system, especially in government service, a commanding officer of peevish temperament or detestable character can make it more than uncomfortable for the officers under his command. The writer knows of one instance where, when the fires were hauled and no work whatever going on in the engineer's department, Sundays for instance, a commanding officer in government service insisted upon the engineer standing watch in a confined engine-room, which order was sustained by the head of the department. Thereupon the commanding officer ordered that the engineers should not be allowed to read or write under the same circumstances. This same individual would come into the engine-room and say, "open the throttle a little wider," and coolly proceed to do so himself. Still, these abuses of power are becoming more scarce and more difficult to practice.

Low water is causing more orders for engines.

The Ithaca Portable Engine.

Progress in the manufacture of portable steam engines, for threshing and farm purposes, has been very great within the past few years, and many valuable improvements have been made.

The illustration on this page represents the portable engine manufactured by Reynolds & Lang, Ithaca, New York. The boiler is of the locomotive pattern, and is jacketed with Russia iron, which renders it cooler to work around and saves heat.

The furnace has a shaking grate, and is provided with means for dumping the fire. An ingenious and very efficient super-heater in the smoke-stack dries the steam, and thus saves a large per centage of water and fuel. The steam is taken from the top of the super-heater to the engine by an 1½″ pipe in a straight line, except one bend, as shown in cut. The smoke stack is provided with a complete spark arrester and steam blower. The engine is of the most approved pattern. The cylinder, frame, guides, and crank box, are cast in one piece, therefore cannot get out of line. The crank shaft boxes are 3¼″ by 8″, and lined with the best babbitt metal. The connecting rod is cast steel, and has a crank pin box 2⅝″ by 3½″, and cross head pin box 2″ by 2½″, both of composition. The cross head has adjustable composition gibs. The crank pin is hollow, and by filling it with beeswax or tallow it makes a perfect self-oiler. The cross head pin is oiled through the upper guide, and all wearing parts can be oiled while in motion. The valve is self balanced, and has a variable cut off. The engine is easily reversed in half a minute, and runs equally well either way. It is furnished with a reliable governor, which has a simple arrangement for changing speed while running, which is important for threshing purposes. Each engine is furnished with a reliable pump or inspirator as desired, and all necessary gauges, whistle, tool box, driver's spring seat, etc. The whole is mounted on substantial running gear and springs and provided with pole, whiffletrees and neck yoke. The entire weight is 4,000 lbs.

ITHACA PORTABLE ENGINE.

Polishing and Finishing Metals.

Forge and Lathe gives the following directions for finishing and polishing steel and iron: To get the beautiful finish we see on the best work, a piece of flour emery-paper, well worn and a little oil upon it, will be found the best thing to use, and when this has been well worked, to get the high polish, a piece of wood flat upon the surface, with some fine crocus, will bring it up to this state; and if any deep scratches be there you will at once observe them, and to remove them, in all probability it will have to be filed over again. The scratches must be removed before any attempt is made to polish. There are several ways of ornamenting the work if you do not wish it to be left straight. First, then, to cross the surface. This is done by folding a piece of emery paper tightly round a file, taking a kind of circular action, by doing which each line becomes, so to speak, connected. Another process of finishing steel is to curl all over the surface with a piece of oil stone that will cut. This is a most difficult thing to obtain, as few stones cut without leaving bright marks. Hold it firmly in the hand, moving it about in all directions, like curling brass. There is no stated number or size of the curl. Another way of finishing iron and steel is with the scraper, which is used with both hands, and the work must be scraped in various directions, but with regularity.

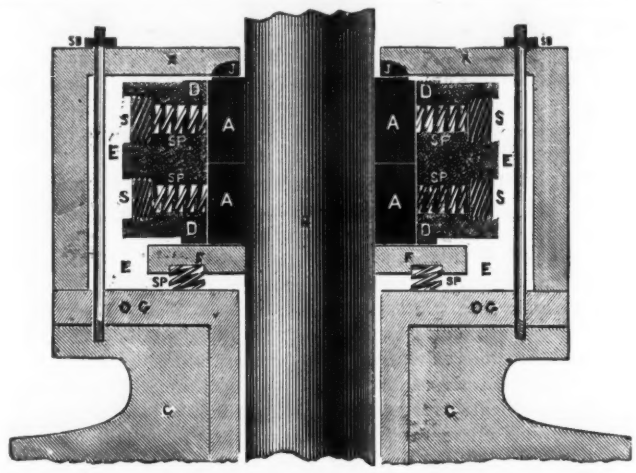
Thorold, Canada, is to have a glass factory, having granted a bonus of $10,000 to that object.

Self-Adjusting Steam-Pressure Packing.

This packing, with the late improvements, consists of eight composition blocks, which are held in a strong brass ring, on which are horns holding springs and set screws. The blocks are regulated by the springs and, it is claimed, keep a steam-tight joint against the rod, simply riding upon it, with no appreciable friction and without binding, as is liable to be the case with packing set up by power on nut of stud bolts.

A ball joint on one side and follower with spring on the other give the packing free play, and keep it steam-tight without regard to vibration of the rod. It is claimed to work equally well whether the rod vibrates or not, and causing no friction, does not wear the rod, but gives it a high polish. The blocks wear slowly, and many can be replaced at slight expense, being the only parts which ever require renewal.

The whole is enclosed in a strong case and bolted to cylinder head, is simple, and easily taken apart if necessary. It is made in a first-class manner, and is claimed to have stood the test of use on the largest steamships, and rods of the largest diameter. It is made by the United States Metallic Packing Co., 85 Devonshire Street, Boston, or 34 and 35 Coal & Iron Exchange, New York.



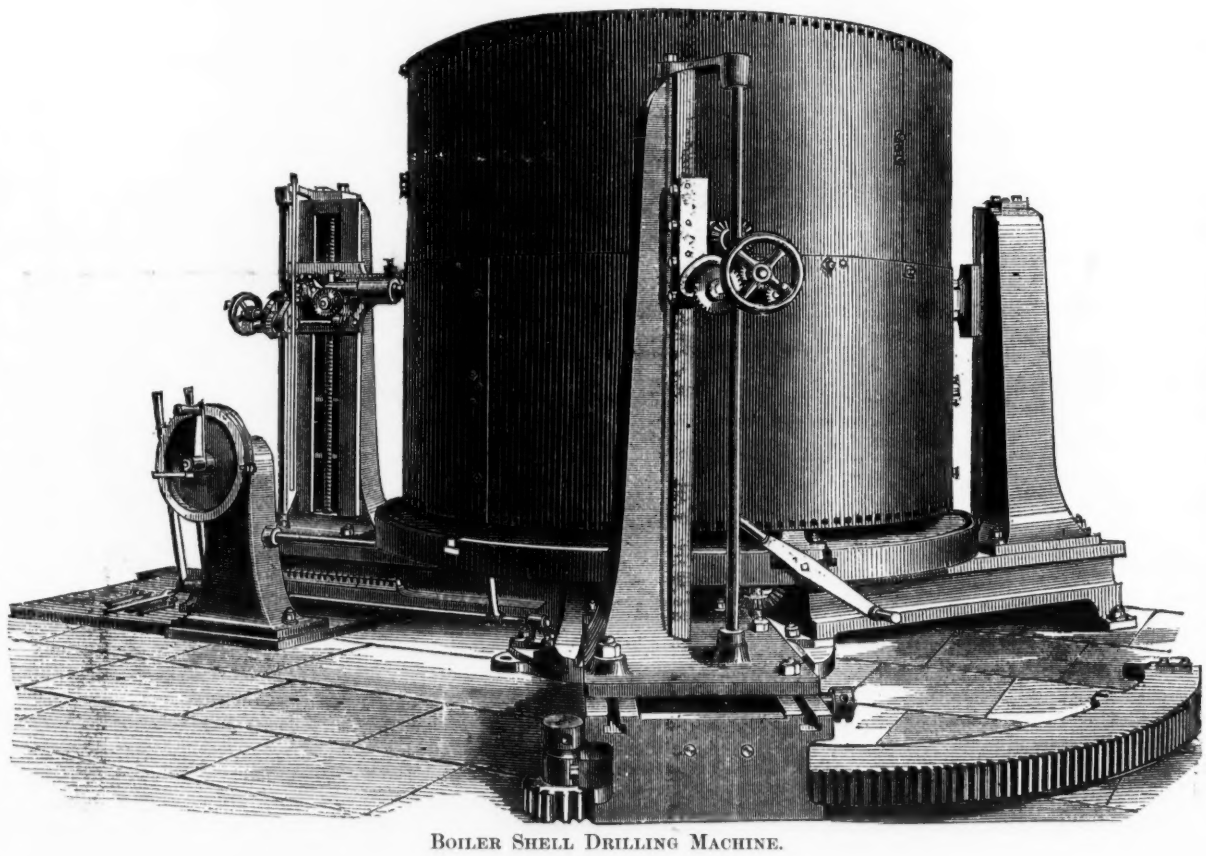
APPLICATION OF SELF-ADJUSTING STEAM-PRESSURE PACKING.

Boiler Shell Drilling Machine.

On these pages are shown two views of a boiler drilling machine, originated by Kendall and Gent, Manchester, England, which we take, together with the description, from a late issue of *Engineering*. The probable reason why machines of this class have not been taken up by our machine builders is their large cost. If, however, they effect a considerable saving in boiler shop work they might be cheap to use, even at a large original cost.

This machine embodies a combination of the Scott patent dividing motion, as used in gear wheel moulding, with "Dixon's patent instantaneous withdrawing motion."

The dividing motion permits the pitch of the rivet holes in the circumferential seams to be regulated to any desired distance without previous "setting out" or "marking off," and the withdrawing motion brings back all the drills directly the holes are completed without any cessation of the feed motion, each drill being instantly ready for the next hole.



BOILER SHELL DRILLING MACHINE.

The machine, as constructed to drill the shells of ordinary boilers and similar circular objects, is capable of admitting boilers of 8 ft. diameter, or any smaller size down to 4 ft. diameter, and is provided with a self-acting lifting and lowering motion to the drill heads, embracing a range of 4 ft. 3 in. in height. Each head, when once adjusted to the diameter of object to be drilled, is bolted firmly down to the radial baseplate, and securely held there during the working of the machine.

The boiler shell is placed upon a revolving table actuated through patent dividing apparatus, by means of a large dividing wheel and worm placed beneath it, and the practical accuracy of this apparatus has been proved in this machine by drilling a complete circumferential row of holes in a 7 ft. diameter boiler shell and passing the drill after the completion of the last hole again to the hole it had started from, into which it freely entered without the slightest visible inaccuracy.

The feed motion to each drill is driven from one source of power, but each drill is adjustable on its own account. The depth of feed is regulated by a patent detent lever which engages with the teeth of a ratchet wheel, till released therefrom by contact with the adjustable stop. The drill spindle is then instantly forced back by the spiral spring and the forward feed motion continues.

It is the duty of the attendant to turn his dividing apparatus handle the required distance for the next hole, directly the drills are withdrawn, the amount of clearance between the drill point and the boiler shell being such as to give him proper time for this purpose but no more. Self-acting water jets to the drills, and reflectors to enable the operator to see each drill, will be provided, but were not in action at the time views of the machine were made.

With an ordinary boiler shell formed in three plates, the three drills work simultaneously, and the one movement of the dividing apparatus, of course, applies to all. If the object to be drilled be not divisible into multiples of three, any other divisions can be produced by the dividing gear, either one, two, or three drills being used, as the circumstances may permit. Two heads can be shifted round from the angle of 120 deg., at which they are shown, to positions diametrically opposite, as may be desired, and the third can be used or disused as wished.

Vertical gauge rods are provided, duly marked out to the various pitches that may be needed for the vertical rows of holes, and the movement of the drill spindle saddles is so simple and steady that accurate adjustment can be made without the least difficulty. In the same way when the drill would, in its natural course, come in contact with one of the bolts by which the plates are held together, the attendant can run all the drills downwards a couple of inches or so, then turn the dividing apparatus two pitches instead of one, and on raising the three drills again he can continue the circular row as before. The entire control of the machine is governed by the attention of one man to two levers and the one dividing handle, which are all conveniently placed for the purpose.

Letters from Practical Men.

FRICTION AND POWER OF BELTS.

Editor American Machinist:

The remarks of Mr. Chas. A. Hague, in No. 27 of the AMERICAN MACHINIST, on the subject of Belting, seem to me to eradicate Chordal's "friction brick" theory, but the laws of friction are too well established to be changed by such mere assertions.

Mr. H. says that "that in a certain 'pocket book' may be found the statement that the width of a belt is independent of the driving force; in other words, a narrow belt will drive as strongly as a wide one, if it—the narrow one—is strong enough to hold together."

Also, that Mr. Rose intimates the same views of the matter.

"Now," says Mr. H., "as I understand the statements, I do not believe any such thing. Weight in a belt adds force; increase in width increases weight; therefore, I hold that it is impossible to drive *as great a power* with a narrow belt as with a wide one, diameter of pulley remaining the same."

Now, allow me to ask if increase in thickness does not add weight to a belt and strength as well? If not, why are double belts so often used, and why are rubber belts made two, three and four-ply, if it is not to add weight and strength to them?

Belts are made of different forms, flat, V, or round; or of different materials, as leather, rubber, steel and iron.

A wire cable when used to transmit power is simply a heavy, narrow, round belt, and regarded from Mr. H.'s standpoint would appear deficient, but being made of material "strong enough to hold itself together," it drives with as much power as a wide one.

It is an established fact, that in all kinds of machinery, where the driving is done by friction, the extent of contact or friction surface is a mere matter of economy or durability, "*pressure*" being the factor which regulates the amount of power transmitted.

Perhaps the most successful narrow belts now in operation are those spiked to the ties between New York and San Francisco.

The points of contact between the driving pulleys and the belts are very small, but Sir Isaac Newton's immense pressure produces such an amount of friction that they will transmit all the power that the locomotive is capable of exerting.

There are several other points in the article referred to, which are open to friendly discussion, but which we will withhold to tempt your forbearance on some future occasion.

Respectfully yours,

GEO. B. DURKEE.

Chicago, Ill., June 23, 1880.

A CONVENIENT NOTE BOOK WANTED.

Editor American Machinist:

Has any body seen, or is there a book made, which will go into a pocket, which is ruled off into squares, say one eighth ($\frac{1}{8}$) of an inch, and so arranged that when the book is full, it may be taken from the cover and replaced by fresh leaves? I never could find one made after this style of a nice size for a general note book. I did once find a book something like what I wanted, but when I had used up the leaves, I found I had to send back to New York for more, as it was an odd size, and being in Denver, Colorado, I found it would not pay. To keep notes is not so hard, but to get them in shape so as to be able to find them within a month or two is not so easy. If such a book is not made, I think any body who would make one as I suggest, with an index and numbered pages, so that matter could be indexed, and thus easily found when wanted, would make money out of it, and a name. I hope any-body who has given this note-taking business any attention, will let us know through this paper, what has been of most use to him.

Yours truly,

NEMO.

EXPANSIVE POWER OF STEAM.

Editor American Machinist:

In your issue of April 10, Mr. Hill, in an article on theory and practice, makes an assertion that is at variance with both theory and practice. He says steam when cut off for boiler has no power. Were it not for the momentum of fly-wheel the engine would stop. Is he guessing, or does he know this to be a fact? I think he is the former, and wild at that. I have been running a Buckeye for a year, and having occasion to move the main eccentric, I tied the loose one back so as to get at the set screw with wrench. While tied, the valve cut off, at one inch (engine 12 by 20), travel of piston. Steam was let on, and engine was started and made a number of revolutions before the eccentric was let back to its position. The engine would, from appearances, have gained its regular

speed if time had been given it, but it was run long enough to demonstrate that steam after cut off from boiler still had power to do work.

In an adjoining city there is an engine 5″ by 10″ plain slide valve which cuts off at 2″. This engine runs the machinery of a small machine shop, and when the engine has been warmed up it can be run as slow as thirty revolutions per minute. It certainly could not do so if the steam had no power after cut off.

H. CHOATE,
Shelbyville, Ky.

THE CIRCLE CONSIDERED.

Editor American Machinist:

Number 27 of present volume contains an article on the circle from the pen of Mr. Pemberton, which will interest many of the readers of the AMERICAN MACHINIST in search of light as applied to circular mechanics.

Following the circle is a geometrical diversion which T. P. P. must have meant to name so in a literal sense, else he must have been occupied, immediately before "copy" was called, in the intricacies of the 13, 15, 14 problem, and omitted to "apply the rule" to the final number points of the star. To make the matter quite plain T. P. P. says positively "that the sum of any two contiguous numbers of the star are equal to the sum of the two numbers opposite," thereby committing himself to the solution; whereas had he left it as a puzzle to be arranged, as suggested in the preceding sentences, he might have started a score or so of smart apprentice recruits to join the army of Gem Puzzle converts, on their march towards the Numerical Insanity Retreat without the honor of leading the crew. "If at first you don't succeed try, try again."

M. P. WOOD,
46 Cortlandt St., N. Y.

THOUGHTS ABOUT BELTS.

Ed'r American Machinist:

I agree substantially with Mr. Hague that increasing the width of a belt increases its driving power, not only because increasing the width increases the weight of the belt, but also for the following additional reasons:

The transmission of power of a belt varies, all other elements being equal, upon the amount of friction between the belt and the pulley surface, and is said by some authorities to be dependent upon the arc of contact and independent of the area of contact. Now, the friction increases directly as the pressure, hence if a double belt be twice as tightly strained as a single one of the same width and thickness, it should transmit double the amount of power of a single one, but such is not the case. The usual power of a double belt does not indeed exceed that of a single one in a greater proportion than 1½ to 1. It may be noted, however, that in a double belt more power is absorbed in the duty of bending the belt while passing over the pulleys, but this is of little moment in any but very small pulleys, as, say of 10 inches or less in diameter.

Again, if we take a single belt and lace it, so that the ends of the belt do not meet within, say, 2½ inches, and strain the belt over two pulleys, and place a continually increasing resistance to the rotation of one of them, a point will be reached at which the belt will draw the pulley at every part in its length, except that at which the lace resists, and the area of contact is reduced. This fact is well known to late operators, who frequently under a heavy cut help the laced joint over the pulley, by pulling the belt by hand. Now, on account of the thickness of the lace, the belt is more tightly strained when the belt is passing over the pulley, hence its transmitting power should be greater if the friction was independent of the area of contact; again a round belt placed over two flat pulleys with a given degree of tension will not transmit as much power as a flat one, placed over the same pulleys with the same degree of tension. Furthermore, a given belt will not transmit as much power to a roughly turned as to a smoothly turned pulley.

And from these facts I am firmly of opinion that the area of contact, as well as the arc of contact, is an important factor in the transmitting power of belts, or in other words that increasing the width of a belt without altering its gross tension increases its transmitting power. To account for this fact, notwithstanding the accepted laws of friction, we have the circumstance that, to whatever degree the air is excluded from between the pulley and the belt surfaces, there is induced an atmospheric pressure, pressing the belt to the pulley, and giving it a driving power in excess of that due to its degree of tension and arc of contact; and it is obvious that the amount of this atmospheric pressure will under equal conditions increase with the width of the belt. It would appear also that the atmospheric pressure will increase as the belt is more tightly strained, and, with the smoothness, flatness and pliability of the belt surface. Indeed it is an acknowledged fact that a belt will drive more with the grain than with the flesh side to the pulley which is proof positive that the nature of the surfaces has an influence on the driving power of the belt, independent of the arc of contact, and the degree of tension. Here I must revert to what Mr. Hague is pleased to term my *favorite* surface plates. If a true surface plate be lowered vertically upon another arc, then moved, it will be found to move about with the greatest ease, there being a film of air between the two which prevents the surfaces from coming into contact. If it then be lifted it will lift the lower plate from a partial vacuum, notwithstanding the pressure of the air. Now *what is the pressure of this film or stratum* of air between the plates if *it were equal to that of the surrounding atmosphere—what lifts the lower plate?*

Again, if a plate be slid across the other, the air is excluded to a greater extent, and the atmospheric pressure forcing the plates together is increased with a corresponding increase of friction. Now a belt meets a pulley by a sliding motion, and it is fairly presumable that this causes a more perfect exclusion of the air than if the belt met the pulley surface while moving at a right angle to the plane of the surfaces in contact; although even in the latter case it would appear from the action of surface plates that there would be a partial vacuum.

What the amount of this vacuum may be depends upon the closeness of contact of the surfaces; for example, the contact will be more perfect, and the exclusion of the air greater with a properly executed, smooth-filed surface than with a scraped one; more perfect with a dead smooth-filed one than with a smooth-filed one, and still more perfect with a file-polished one than with a dead smooth-filed one; the practical maximum of air exclusion being attained when the file polish is such that no marks of any kind or in any direction are visible to the naked eye, the surfaces having a polish due to the friction of contact under motion, hence a belt that has been rendered more pliable by the application of oil might be expected to be closer to the pulley surface, and induce more atmospheric pressure on the back of the belt. Experiments made by various authorities bear out these expectations, and confirm the theory that atmospheric pressure exists to some extent on the belt, because such experiments have given the varying results that might be expected, on account of the difference in the bed of the different belts experimented upon to the pulley surface.

If this latter be admitted, then it substantiates the claim that the area of contact is a factor in the calculation, as the amount of atmospheric pressure will increase with an increase of area of contact, though the arc of contact remains the same; as would be the case if two belts were used upon the same diameter of pulley, and both having the same total amount of tension, but one being of greater width, in which event the drawing power of the latter would be increased in proportion to the extra friction induced, by the atmosphere.

I do not remember to have at any time read, or heard a reason given by any authority, why increasing the arc of contact of a belt should increase the driving power of a belt *independent of the fact that it increases the bearing area;* and it seems to me that the sole animus in claiming that an increase in the arc of contact does, and an increase in the width of a belt does not increase the belt's transmitting power is for the purpose of sustaining the accepted laws of friction at any cost, although it seems to me that by accepting the fact of an atmospheric pressure as existing on the belt (which is entirely consistent with common sense), the laws of friction could be better sustained; but in this case an element of uncertainty would be introduced that would impair the value of the cast-iron rules for calculating the power of belts, unless, indeed, the amount of such pressure, under average condition, be ascertained and taken into account.

A practical and easy method of letting light in upon this subject would be to take a lathe, and put on a cut sufficiently heavy that the belt will just drive it without slipping, then cut off the edges of the belt for a distance equal to about the circumference of the slip of the cone pulley on which the belt ran, reducing the belt width to one half, and start the lathe again. I think it will be found that the narrow part will not drive the cone, but will have to be helped by a hand pull, which the wide part will not require.

In a recent communication to a Boston paper by J. H. Cooper, there appears the following:

"It is very true, that if the belt does not touch the pulley, it cannot pull it around, nor can it be driven by the pulley. It is also true, that if belt and pulley touch on a limited area only, each can drive the other with a force but a part of what it is capable of doing, and it is only when contact is made perfect—that is, when every square inch of the belt, so to speak, is down solid on the pulley surface, which surface we will grant is very smooth—that the greatest driving effect is obtained."

Will Mr. Cooper inform us, first, whether this fact bears out the theory that the friction is as the pressure, and independent of the area of contact? and 2nd, will he give us some reason for those acknowledged facts in which reason increased area and atmospheric pressure are to be omitted?

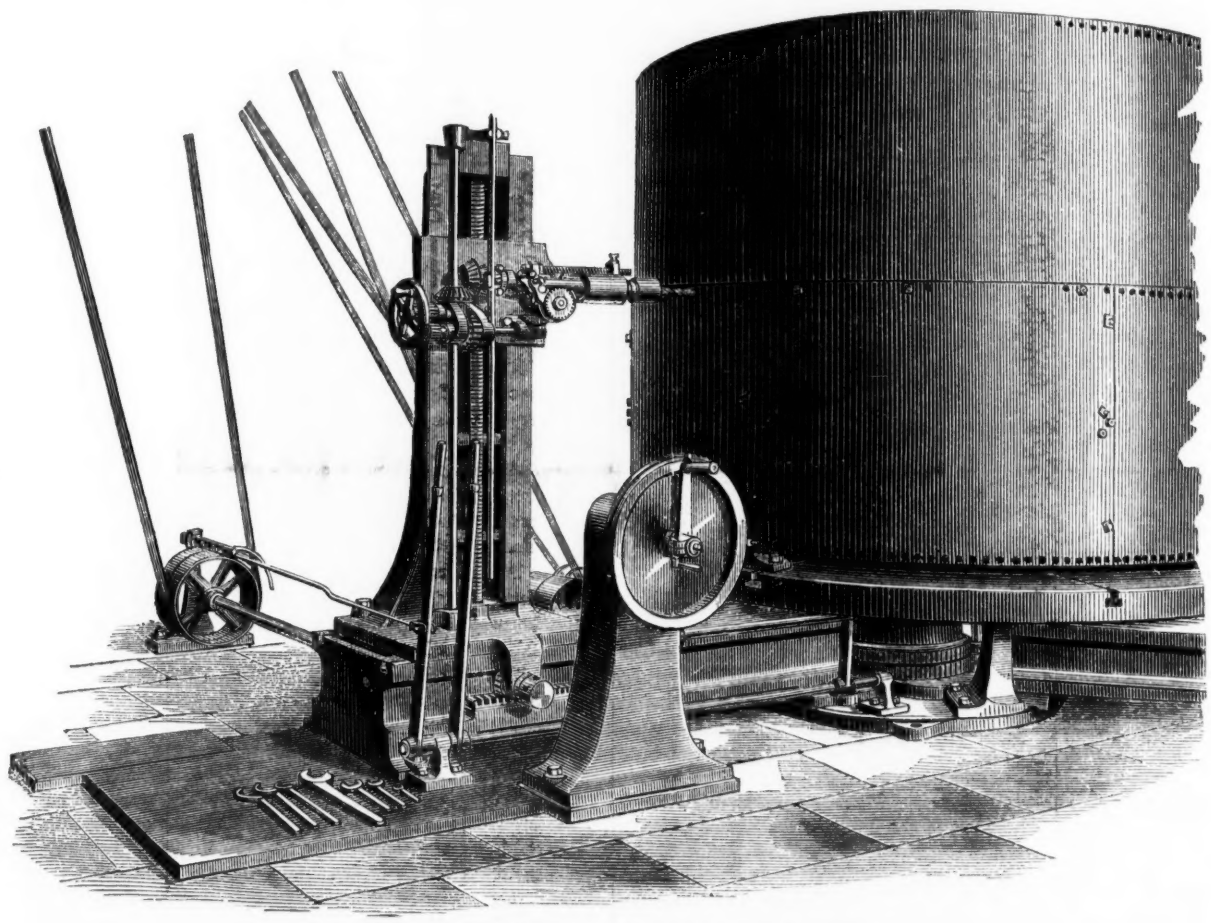
In the same communication appears the following:

"The atmosphere does not press two bodies together when it can get between them. It is only when excluded by a tight joint that the development of its pressure is possible; and it becomes sensible only when an effort is made to separate them by a force acting at right angles to the plane of their faces."

I do not find this to be the case, as my cited surface plate experiment attests, when with a film of air between them, the top lifts the bottom, and I am tempted to again ask what holds the bottom plate up?

I may here remark that if the lathe experiment is made it should be with a belt soft and pliable, and not upon a new belt, but one having a smooth, flat surface, and, if possible, upon a flat, and not upon a crowing pulley, or, what would be better, upon both, because an experiment upon a new belt would, in many cases, be almost valueless, because of the low places of the bell surface containing pockets of air.

JOSHUA ROSE, M. E.
New York, July 1st, 1880.



BOILER SHELL DRILLING MACHINE.—SEE PAGE 6.

In the course of next year, plate glass works will be established at Black River, Ohio. Mr. Hogan, lawyer of Illyria, is the President of the Company organized for the purpose.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Prest.

JACKSON BAILEY, Vice-Prest.

LYCURGUS B. MOORE, Treas. and Sec.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

LEWIS F. LYNE, Mechanical Engineer.

The American News Company,

Publishers' Agents, New York.

The International News Company,

(Formerly the Wilmer & Rogers News Co.)

11 BOUVERIE STREET, (Fleet St.) LONDON, ENG.

Will receive subscriptions for the AMERICAN MACHINIST at 17 shillings per annum, postage prepaid.

DEALERS SUPPLIED BY

The New York News Company, New York.
The National News Company, New York.
The New England News Company, Boston, Mass.
The Central News Company, Philadelphia, Pa.
The Western News Company, Chicago, Ill.
The St. Louis Book and News Co., St. Louis, Mo.
The Cincinnati News Company, Cincinnati, Ohio.
The Detroit News Company, Detroit, Mich.
The Pittsburgh Book and News Co., Pittsburgh, Pa.
The Baltimore News Company, Baltimore, Md.
The Rhode Island News Co., Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The Brooklyn News Company, Brooklyn, L. I.
The Newark News Company, Newark, N. J.
The Northern News Company, Troy, N. Y.
The Albany News Company, Albany, N. Y.
The Washington News Co., Washington, D. C.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

SUBSCRIPTION.

$3.00 a year, in advance, postage prepaid in the United States and Canada.

$4.00 to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 30c. per line, (12 lines one inch.)

"Business Specials," 40c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers who fail to receive their paper promptly will please notify us at once.*

☞ Entered at the Post Office at New York, N. Y., as second class mail matter.

NEW YORK, JULY 17, 1880.

CONTENTS.

	PAGE.
A New Mechanical Movement	1
Address to Graduate Engineers	1
Extracts from Chordal's Letters	2
Practical Draughting-Gearing.—T. P. Pemberton.	3
A New Balanced "Plumb-Bob."—A. Forrest	3
Working Drawings of a Steam Engine—Elevation of Cylinder	4
Keying up Locomotive Side and Main Rods.—Frank C. Smith, M. E. (V. Hook)	4
Management of Marine Engines—Getting under Way, Accidents, &c.—Alfred R. Wolf, M. E.	5
The Ithaca Portable Engine	5
Polishing and Finishing Metals	5
Self-Adjusting Steam Pressure Packing	6
Letters from Practical Men	6
Selecting Water Works Machinery	8
Technical Education	8
Hymeneal	8
Machine Shop Extravagances	8
Questions and Answers	9
Manufactures	9
Machinists' and Engineers' Supplies	10
Iron Review	10
Metal Review	10

Selecting Water Works Machinery.

It would be difficult to discover any substantial reason why the purchase of pumping engines for city water works should not be governed by the same commercial principles as the purchase of machinery for a private establishment. When a manufacturing concern orders a steam engine for power a careful examination is made of the peculiarities of different styles of engines and their adaptability to the required work. A selection is made of the one which seems best suited to the requirements at the most reasonable price. Very few business men would buy an engine built upon an experimental plan, and trust entirely to it for the running of a large workshop. Very few would publicly invite engine builders to send competitive estimates for furnishing a large engine, and upon this basis place the contract with the lowest bidder. Yet this is the plan pursued by most city water works' boards when a pumping engine is required to supply the town with water. They seem to consider it an unwarrantable departure from a position of absolute justice to every probable competitor for the contract, to examine thoroughly well-tried pumping plans and systems before asking for estimates. The result is often a complete failure of machinery depended upon for supplying a town with water, and much trouble among the citizens in consequence. Occasionally, however, the water-works trustees of a city are wise enough to provide against errors of this character. Newport, Ky., recently presents an example of the kind. Instead of being governed by first cost and contractors guaranties, the trustees appointed a board of experts to investigate all the plans offering and report the facts.

Following is their resolution:

Resolved, That the Board of Experts to whom the plans and specifications and proposals for Pumping Engine are to be referred, be and they are hereby instructed to make a thorough examination of same, and report to this Committee their judgment of the relative *order of merit* of the several plans offered.

In making the comparisons they will give due weight to first cost and duty, strength and adaptation of the several parts of each machine to the work it has to perform, and should it be deemed desirable that either one of the two pumps might continue to be operated independently, at pleasure or when necessitated by accident, to either steam or pump end of the other, then that feature will also be duly considered.

Due regard will also be paid to precedent, it being undesirable to undertake the construction of machinery on any plan or principle which has not been duly tried by time and proved successful.

While a low cost is desirable, it is not expected to outweigh the consideration of future economy and repairs.

It is expected that the Board of Experts will suggest any changes not material in extent, which they might advise as being desirable, and which would add in any way to the efficiency of the machine or machines recommended for acceptance.

It may, therefore, be expected that Newport, Ky., will have a reliable and economical water supply. We commend this course to the Water Commissioners of other cities.

Technical Education.

We present elsewhere in this issue some extracts from an interesting address, delivered before the graduating class of the Rensselaer Polytechnic Institute, by Mr. Francis Collingwood, a practical engineer of high professional standing, and one of the alumni of that institution. In that address he pays an unusually, high compliment, but one well deserved, to the thoroughness of the course and its effect upon those students who complete it. Without detriment to any other of our excellent schools of engineering, it is no exaggeration to maintain that the Rensselaer Polytechnic Institute stands at the head of technical institutions in this country. Its graduates are not only extensively sought for, but are noted for working their way into the most important positions. The officers and chief engineers of our leading railroads, as well as the instructors in other technical schools, and managers of prominent manufacturing establishments, are largely recruited from Rensselaer graduates. Several of the valued contributors of the AMERICAN MACHINIST are alumni of this institution of learning. One whose productions appear frequently graduated in the class of 1839, and another whose name has stood at the head of a valuable series of articles which we published on steam engineering, graduated in the class of 1872.

It is to be regretted that the opportunities to pursue a thorough course in a technical institute are open to so few who are desirous of securing its advantages. The cost of pursuing a full course in almost any well conducted institute of this kind is large enough to deter thousands from entering upon it, who have the most laudable ambition to fit themselves for engineering occupations. Apprenticeship in commercial workshops is not a substitute for the advantages offered by a thorough technical school, yet it may be considered an excellent auxiliary. The more fully our technical institutions are endowed the greater will be our national mechanical progress, for their doors will be open to more young men of limited means, anxious to avail themselves of the advantages of a technical education. The state will not furnish the endowments, therefore the liberality of private individuals must be relied upon to extend their beneficent influences. It is not desirable to make charitable institutions of our engineering schools, but to lighten the expenses for students unable to sustain a large outlay.

Hymeneal.

On Wednesday, June 30th, at the Church of the Holy Communion, corner of 20th St. and Sixth Avenue, New York, Mr. Lycurgus B. Moore was married to Miss Helen, daughter of the late Henry B. Jenkins, Esq., by the Rev. Henry Mottet, according to the rites of the Episcopal faith.

As Treasurer and Secretary of the AMERICAN MACHINIST PUBLISHING CO., and Treasurer of the American Society of Mechanical Engineers, the bridegroom's substantial qualities of head and heart have gained for him the confidence and esteem of all who know him. He is to be congratulated that they have also won him the tender companionship of one who will look after his welfare, and continually make him feel glad that he was born. The bridal couple are now sojourning temporarily in Canada. They will return in about two weeks by way of the White Mountains.

Machine Shop Extravagances.

It would be a vain attempt to give in a single article anything like an adequate idea of the different degrees of extravagance practiced in machine shops under the false name of economy.

If there is one class of shops that are subjected to this evil more than another, it is the railroad shops. The general practice in these shops is to manufacture the taps and dies required for their own use, thinking that by so doing they secure a cheaper, and in some instances, a superior article.

We cannot call to mind a single circumstance where this claim has been justly made. It is impossible to construct a superior tool from poor steel, or to get a uniform quality. Very few manufacturers of tool steel will furnish an absolutely uniform quality, and if the quality of the steel is not uniform, the same treatment and color in tempering will not be satisfactory. The only way that the manufacturers of the best taps and dies have succeeded, has been by adopting a brand of steel which is made by a reliable manufacturer, who will furnish the same grade every time it is ordered.

The men very soon get used to working a good quality of steel, and it does not pay to experiment, for every manufacturer knows the damage caused to his business reputation by allowing an order to be filled with doubtful goods. In addition to the adoption of a uniform quality of steel, the manufacturer also expends large sums of money in inventing and perfecting the best and most economical machinery. Many of these machines are made to work automatically. By making a specialty of taps and dies, the adoption of the best material and machines, the manufacturer is enabled to produce the best quality of tools at a cost so low as to render it wasteful for shops to make their own. In railroad shops a requisition is made for a lot of tool steel. In some cases, the purpose for which it is intended is mentioned but oftener neglected. The purchasing agent is not expected to be an expert in metals, and therefore has to trust largely to the representations of the dealer. In this age of invention, it is of frequent occurrence that a new quality of tool steel is made for experiments, which the manufacturer, of course, mentions to his customers, and as the new steel is generally furnished at a reduced price, there is an inducement for the purchaser to test the quality.

In this way steel gets into railroad shops which is entirely unfit for making taps and dies, but which must necessarily be used.

In order to make good tools the steel must be properly annealed which operation is very seldom accomplished in the shops referred to. The plan for annealing is generally of the most crude nature, and is only a partial success, so that in working badly annealed steel extra time is consumed, tools are dulled, and a poor piece of work is the result.

We have repeatedly seen a tool made at an expense of about five dollars, which might be bought at any supply store for seventy five cents, and all through the defective system of purchasing material. In making taps in these shops no two are likely to be the same size. In tempering they become crooked, and in use they rapidly wear away, so that a keg of nuts tapped last month and sent up the road will be found too large for bolts cut at the present time. This is caused by the wear of the taps. These disadvantages become more apparant in the manufacture of pipe tools as the dies being solid cannot be adjusted to make up for the wear. The dies wear larger and the taps smaller, and if much used, the pipe cut with these dies will enter the standard fittings only two or three threads. We have known qute serious accidents to occur, through these imperfect joints upon a steam pipe giving way, and causing the steam to escape. Taps and dies can generally be bought of the manufacturers for about one third of what it costs to make them in a railroad shop. They can be relied upon as being of a uniform size, and will wear well.

In many shops the managers still persist in using the common flat drills, thinking that they are the cheapest and most economical, but the fact is, twist drills may be bought for less money than it costs them to make the flat drills besides cutting much faster, and doing far superior work. Simple as the common flat drill appears to be, we have found very few men who could bore a hole with it, round, straight and of a diameter corresponding to the width of the drill.

Another branch of extravagance, practiced in machine shops, is the duplicating of small parts of tools and machinery, as for instance the valves or inside parts of injectors. These parts may be purchased from the manufacturers at much less than they can be made for, and the special tools used in their manufacture cost in many cases several thousand dollars. It would be folly to purchase those machines unless it was intended to make a business of manufacturing the same articles.

We know a proprietor who thought he would like to use twist drills, and decided to make them. After making a few he found that they were costing him about two dollars each, and the same size could be bought for twenty cents, but we never saw any of the style he was making for sale in any store. We are sure they would bring forth comments and smiles from good mechanics.

Another case was that of a superintendent in a railroad shop, who was opposed to buying anything whatever, but believed that all things required for repairs should be made in the shop. Accordingly, he fitted up for making the needles or feeders required for oil cups, and found to his astonishment that they each cost about fifty cents, when they could be bought of the manufacturer for ten

cents. A certain size of brass rivets with button heads were required to rivet up a boiler jacket. A requisition was made, and the information sent to the shop that the rivets could not be found in the market. Accordingly, some brass wire was ordered, and some dies were made, with the intention of producing the necessary number. Every one who has ever made the attempt to put a head upon brass wire with ordinary means can imagine how well they succeeded. Suffice it to say that the rivets, besides being of the poorest quality, cost twenty times as much as they should. After they were finished it was discovered that they could be bought in the market, and a number was purchased which will be sufficient to rivet up all the jackets required upon the road during the remaining eighty years of their lease.

These incidents, together with others that might be mentioned, prove that by exercising a little judgment in shops before commencing anything out of the usual course, a great saving might be effected. If on railroads where these practices are carried on, some of the red tape were abolished, and the practical mechanic allowed to select his own material, larger dividends might be secured to the stockholders.

We have carefully scanned the columns of our heaviest Melbourne exchange (a 56 page monthly) since the beginning of the present year, for some facts about the International Exhibition about to be held in that city, but have failed to find the slightest reference to that important enterprise. Perhaps public spirit in the Australian metropolis does not favor the undertaking, but we find in the last issue an editorial item which gives some intimation of the drift of public favor. It is as follows:

ENCORE WHISKY.—This spirit is rapidly gaining ground in public estimation. The agents at the moment are sold out of stock, but have a considerable parcel due.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) F. S. B., Tiverton, R. I., writes: I have a boiler which was taken out of a steam vessel of 100 tons burden, and is capable of supplying a 20″×22″ cylinder steam engine, which makes 100 revolutions per minute. The boiler, in style, is of the ordinary type used in marine service at present, having two furnaces, each being 3×6 feet. The furnaces each have three flues communicating with the back connection, from which the products of combustion pass through tubes to the uptake or steam chimney. Since this boiler has been in use it has produced a mournful sound called drumming, which can be heard a distance of five miles, and is very annoying. I have tried everything that I could think of to stop it, and find that the only thing that will have any effect is to admit a very small quantity of air under the grates. It stops the noise, but impairs the steaming qualities of the boiler. Can you give me any information on the subject? A.—The noise referred to may be produced through numerous causes, and may sometimes be attributed to only one. You do not state whether the space under the grates is divided, thereby making a separate ash-pit for each furnace. We are acquainted with a case where a very disagreeable sound was produced in a similar style of boiler, by a cross draft in the ash-pit. The difficulty was fully overcome by placing a partition in the center, thus making a separate ash-pit for each furnace. In your case, you speak of admitting a small quantity of air under the grates, which would seem to indicate that the draft is intermittent or broken. In that case the drumming may be caused by back draft. This may be cured by the application of a blower, which will give a steady draft. You should carefully examine the passages in your furnace and boiler, also the chimney, to see that there is no obstruction. Observe that the top of the chimney is not obstructed by a higher building or trees, in which case it should have a proper top placed upon it. Please send us more data in the way of dimensions of passages, height and style of chimney, etc.

(2) J. O. R., Doboy, Ga., writes: I have been running a surface condensing engine, and have considerable trouble with the ferrules in the condenser, which are of wood, and would like to get your opinion as to which kind of ferrules are the most durable? A.—Wood has been supplanted by paper as a superior material for ferrules to be applied to the ends of tubes in surface condensers. The ferrules are made from strips of a special paper closely rolled. The inside is made to slip over the tube, and one end is tapered. This process is patented.

(3) A. C. Stillwater, Minn., asks: 1st. Will you tell me of a rule to find the average pressure of steam on the piston (of an engine) per square inch when the boiler pressure is known? A.—The average or mean effective pressure upon the piston of a steam engine can only be accurately determined by the application of an "indicator." The instrument must be of a proper design and reliable, otherwise the test will be unreliable. 2nd. Where can I get a good work on portable and stationary engines? A.—A Practical Treatise on the Steam Engine, by Arthur Rigg, price $17.00, is a most complete work on the subject; or if a cheaper treatise is desired, procure Roper's Hand-Book of Land and Marine Engines, price $3.50.

Business Specials.

40 cts. a line for each insertion under this head.

Vertical and Horizontal Pumps. Capacity from 100 to 35,000 galls. per minute. Simple, Efficient, Economical, Durable. Used by more than half the tanners and paper makers of the country. Horizontal and Vertical ENGINES, from 10 to 30 H. P., for long continued hard work. Prices, 40 per cent. below other makers. Send for circulars. Heald, Sisco & Co., Baldwinsville, N. Y.

Lathes, Planers, Shapers, Drills, Bolt and Gear Cutters, Milling Machines. Special Machinery. E. Gould & Eberhardt, Newark, N. J.

Engines, Hoisting and Pumping Machinery for Mines. The Band Friction Hoist, which is the safest, simplest, strongest and best in the market. Also, Friction Clutches. Address, Webster Camp & Lane Machine Co., Akron, O.

American Watch Tool Co., Waltham, Mass. Lathes, Watch Case, and Clock-Making Machinery.

W. D. Skidmore. Machinery designed and executed and superintended if desired. Patent Office drawings. Hours 9 to 6. No. 733 Broadway, N. Y.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co, Jersey City, N. J.

Drop Hammmers. Stiles & Parker Press Co., Middletown, Conn.

Wilkinson & Crowell, 1201 Beach St., Philadelphia, make an Improved Metallic Piston Rod Packing, which is entirely automatic and of great durability. Works well at high or low pressure, and can be used in common stuffing box, or without any stuffing box at all.

See Christiana Machine Co.'s adver., next number.

Norris & Rutter, Mechanical Draughtsmen and Patent Solicitors, 424 Walnut Street, Philadelphia.

To Manufacturers and others: We are prepared to build all kinds of machinery. Patent Articles a Specialty. Correspondence Invited. Mather & Newitt, Practical Machinists, Leominster, Mass.

W. Barnet Le Van, Mechanical and Consulting Engineer, 3607 Baring Street, Philadelphia, Pa.

John Douglass, common and fine patterns made to order, also car wheels, working models, and experimental machinery. Shop at Washburn, Hunts and Co. Wheel Foundry, cor. Warren and Bay Sts., Jersey City, N. J.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

Second-hand 80 H. P. Tubular Boiler for sale cheap; also one large Blower. David W. Pond, Worcester, Mass.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

MANUFACTURES.

The bark Rialto lately loaded in New York City with supplies for the construction of the Imperial Brazilian, Natal & Nova Cruz Railway, now in course of construction for that government, by American contractors. Four different and complete outfits for the railway water stations, comprising windmills, 18 feet diameter of wheel, with pumps, pipes, tank valves, and spouts have been completed, and are now ready to be set up at four different points on the line of the railroad, according to detail drawings made for the work. These windmill water stations were built by A. J. Corcoran, of 76 John St., this city, and the machinery was inspected and accepted on behalf of the Brazilian Government, by A. S. Whiton, N. Y. City. Mr. Corcoran says this is the second shipment he has made for the same railroad.

General Manager Williams, of the Cincinnati, Hamilton & Dayton railroad, has not only increased the pay of his passenger conductors, but has decreased their work.

The new buildings of the Western File Works, at Beaver Falls, Pa., are nearly completed, and are ready for the heavy machinery Forging and hand-cutting was recommenced three or four weeks since. The facilities for production will be considerably increased, as the new works are much more extensive than those recently destroyed by fire.

The Union Rolling Mills of Chicago are progressing rapidly with the work on their new blast furnaces, the foundations for which are now completed, and the brick work well under way. It is expected that both furnaces will be under operation by October first.

Arrangements have been made for the removal of the Forsyth Scale Company's Works from Erie, Pa., to Youngstown, Ohio, John Stambaugh, Robert McCurdy and William Tod, of Youngstown, are among the men interested in the enterprise. When it has been completed and the works are running in Youngstown, employment will be given to 100 men. A letter has been received from Russia asking for the establishment of an agency for the sale of the scales there.

The Orvis Smoke Consuming and Fuel Saving Company of Cleveland, Ohio, capital stock $100,000, has been incorporated in shares of $100 each, by Thomas Wilson and others.

The Cincinnati (Ohio) Steam Supply Company has been incorporated, capital $1,000,000, in shares of $100, by H. Kessler and others.

The manufacturing business of H. A. Williams & Co., of Taunton, Mass, has passed into the hands of a corporation, to be known as the H. A. Williams Manufacturing Company, with a capital of $50,000. The boiler house for the new factory is nearly completed.

The Athol, Mass, Co-operative Furniture Company have voted to double their capital stock.

D. Saunders Sons, Yonkers, New York, have just shipped an 8 inch pipe cutting and threading machine to the Providence (R. I.) Steam and Gas Pipe Co.; also one 4 inch machine to San Francisco.

Mr. Joseph D. Weeks of Pittsburgh, Pa., special agent in charge of statistics of the manufacture of glass for the coming census, has prepared a directory of the glass works of the United States.

The Miller Company, Canton, O., are fitting up a new iron foundry.

The Union Rolling Mill Company of Cleveland, O, a newly organized company for manufacturing iron, have mills, formerly operated by the Union Iron Works Company, which will soon be started up.

The Stockwell Screw and Machine Company, Cleveland, O., have been compelled to increase the number of their hands.

The Cuyahoga Works, Cleveland, O., are about to build an addition to their shops. They are crowded with orders for steam hammers, blowing engines, also stationary and marine engines.

The New Castle (Pa.) Machine Works are now run on the co-operative principle by a number of the workmen, who are said to pay a rental of $8 per day for the plant.

Many of the mills in Maine have been obliged to shut down on account of low water.

The plow manufacturers of Maysville, Ky., report an increase of fifty per cent. in their business during the year.

Wm. T. Bate & Son, East Conshohocken, Pa., have just furnished and put in two of their large Patent Feed Water Heaters and Filters; one for Geo. Bullock & Co.'s Balligomingo Woolen Mills, near that place, and one for Fitzpatrick & Holt's Canton Mills, at Manayunk near Philadelphia. These heaters are giving perfect satisfaction, heating the water to 218°.

Wm. T. Bate & Son, East Conshohocken, Pa., have on hand quite a number of orders for their Bate's Patent Steam Generator. They are now putting one in for Samuel Tinkler, of Gulf Mills, Pa., a 100 horse-power. In a visit paid to Fulton's furnaces, at Norristown, Pa., the manager of the boiler department stated that the Bate boiler just put in there is the first that has ever been in use in a blast furnace; that it is doing the work of two cylinder and one tubular boilers of the old make, and that exactly one-half of the labor is saved, and fully 35 per cent. in fuel.

The citizens of Steubenville, O., evidently do not mean to go dry this summer, says the *Boston Bulletin*, having subscribed $7,000 towards the building of a brewery. The new company proposes to start with a capital of $20,000, and the project will be pushed along rapidly. It is stated that upwards of $70,000 worth of beer is sold annually in that city.

The Holyoke (Mass.) Machine Co. write us: "We are now in distress because we have taken more orders than we can fill." The demand for their Hercules Turbine Water Wheel is surprising.

The Union Brass Manufacturing Co., Chicago, intend to make a large addition to their establishment.

The Tuttle & Whittemore Co., of Naugatuck, Conn., are to erect another new building in connection with their establishment. One of the large boilers is to be reconstructed, and the main engine is running by one whilst the work is in process.

A new firm has been formed to operate the Weimar Machine Works, at Lebanon, Pa. The car building department, which has been idle for several years, will resume work.

Virginia parties contemplate establishing a boot and shoe factory at Martinsburg, Elliott County, Ky.

David R. Pierce, for 26 years treasurer of the Detroit (Mich.) locomotive works, recently changed to the Buhl iron-works, has never missed paying off the men a day in all that time, He has paid out $10,000,000 meanwhile, more than $1,000,000 of it in wages.

A proposition has been made to the city of Akron, O., by capitalists, to build water works as a private enterprise. It seems likely that some agreement of this kind will be entered into.

A large quantity of railroad iron has been forwarded from the United States to Mexico for the Tehuantepec railroad. Several miles of track have been laid and construction trains are running.

California is turning its attention to iron at last, a blast furnace for iron being in course of construction at Clipper Gap on the Central Pacific. It is said to be the first in the State.

The N. Y. Central Railroad has completed and put into service the third locomotive built upon the new plan, with an appliance for arresting cinders and dirt. The stack is straight, and has no cone at the top. The boiler projects about three feet ahead of the base of the smoke-stack. These locomotives work very satisfactorily, and more of the same kind are building in the shops of the company at Buffalo.

Bessemer steel, says the *Railway Age*, is now produced of so good a quality, that competent judges assert that ere long it will supersede crucible steel even in the cutlery manufactories of Sheffield. Already, as it appears, they are making the cheaper grades of cutlery, edge tools, etc., from this product, some 50 to 75 per cent. in value of goods produced being accredited to the use of the best quality of Bessemer.

Since the suspension of the Reading Companies, 775 employes have been dismissed. Of these, 225 were employed in the machine, blacksmith, and car shops at Reading, while the balance were mechanics, helpers and laborers from different shops along the line.

Returns of the Census so far received, make the population of Boston 352,345; Chicago, 474,404; Providence, 104,500; Norwich, Conn., 21,050; Pawtucket, R. I., 19,530; Newport, R. I., 15,405; Woonsocket, R. I., 16,010; and in round numbers, St. Louis, 375,000; Baltimore, 350,000; Cincinnati, 250,000; Cleveland, 158,000; Milwaukee, 130,000; Detroit, 100,000; Indianapolis, 77,000; St. Paul, 42,000; Reading, Pa., 43,000; Dayton, O., 39,000; Springfield, Mass., 31,500; Springfield, Ill., 19,000; Lowell, Mass., 61,000; Denver, 34,000; Camden, N. J., 37,000; Peoria, Ill., 28,000; Minneapolis, 45,000; Philadelphia, nearly 850,000; Brooklyn, 560,000; and New York over 1,200,000.

The one hundred and sixty-second monthly report of the Hartford Boiler Insurance Co. (for March, 1880) shows a very large increase in the number of boilers inspected and insured during the first quarter of this year, as compared with the first quartet of 1879, the increase figuring up 40 per cent. We take the following from the summary of report published in the *Locomotive* for May:

The figures for the month of March, 1880, show the following footing: whole number of inspection visits, 1,975. Whole number of boilers examined, 4,155. Whole number of annual internal thorough inspections, 1,313. The hydrostatic test was applied in the usual auxiliary way to 323 boilers, a very large percentage of which were new, and in the shops and yards of the makers.

The whole number of defects discovered was 1,902, of which 339 were of a dangerous character. The percentum of dangerous defects as here reported is far below the average, and it would be pleasant to believe that this, too, is an indication of improvement in boiler management, but we are not warranted in so construing it till further proof of a real and steady decrease of this percentage is shown. It is to be hoped that this may be realized.

The character of the defects is shown by the following details. Furnaces out of shape, 114—23 dangerous. Fractures, 176—84 dangerous. Burned plates, 132—26 dangerous. Blisters, 376—17 dangerous. Cases of sediment and deposit, 180—30 dangerous. Incrustation and scale, 279—26 dangerous. External corrosion, 80—25 dangerous. Internal corrosion, 105—16 dangerous. Internal grooving, 10—4 dangerous. Water-gauges defective, 43—4 dangerous. Blow-out apparatus defective, 15—4 dangerous. Safety valves overloaded, 18—7 dangerous. Pressure gauges defective, 161—38 dangerous. Boilers without gauges—166. Deficiency of water, 7—6 dangerous. Braces and stays broken, loose, and otherwise defective, 50—29 dangerous. Number of boilers condemned, 52.

The increase in the number of condemned boilers is something notable, being almost double the average monthly for the six months next preceding, and more than 2½ times the average monthly number for the year 1879.—Considered in connection with the fact that the record of explosions in the first third of this year, as reported in *The Locomotive*, is at the rate of 165 per annum, and shows 25 per cent. increase over ⅓d of last year—and almost 60 per cent. over the average for the 12 years next preceding 1880, this fact of 52 condemed boilers in a single month is significant indeed. It means that the boilers that were in use at the time of the late revival in business were below the average condition as to safety, having been used after becoming defective without receiving the economic "stitch in time," which would perhaps have been applied had they been under inspection, and business flush.

Wood Preservation.

At the last annual meeting of the American Society of Civil Engineers a committee was appointed to report upon the preservation of timber. They have prepared the following circular requesting information upon the subject. Any reader of the AMERICAN MACHINIST, who will forward Mr. Harrod, the Chairman, any of the desired information, will be entitled to our thanks as well as those of the committee.

To Engineers, Architects, Preservers of Wood, Chemists and others:

The undersigned, a Committee of the American Society of Civil Engineers appointed to report upon the Preservation of Timber, earnestly solicit information concerning past experience in the impregnation and preservation of that material.

Particulars of failures in this country, and if possible the reasons therefore are especially desired. Also, information on the following points, in each of the processes, which may have been used:

1. Kind of Timber operated on, green or dryage, dimensions, etc.
2. Preserving ingredients injected.
3. Quantity injected per cubic-foot or tie.
4. Mode of application, process, time employed, degree of heat, pressure, vacuum, etc.
5. Subsequent use and exposure of timber, (bridges, building, or track.)
6. Result of preparation and comparison with life of unprepared timber.

This special and any general information on the subject is respectfully solicited.

Replies can be mailed to the Chairman of the Committee.

B. M. HARROD, Chairman, 122 Common Street, New Orleans, La.
G. BOUSCAREN, 82 West 3d Street, Cincinnati, O.
E. R. ANDREWS, 10 Warren Street, New York City, N. Y.
E. W. BOWDITCH, 60 Devonshire Street, Boston, Mass.
Col. GEO. H. MENDELL, U S. Engineer, San Francisco, Cal.
J. W. PUTNAM, P. O. Box 2734, New Orleans, La.
Committee.

Experiment has shown that if 50,000 pounds, once applied, will just break a bar of iron or steel, a stress very much less than 50,000 pounds will break it if repeated sufficiently often. Wrought iron will crystallize and break easier than cast iron. It is well known that wrought iron, subjected to continuous vibration, assumes a crystalline structure, and its cohesive power is much deteriorated thereby.

A Sheffield manufacturer is reported to have told his workmen to vote just as they pleased—"in fact, I shan't tell you how I'm going to vote," he said. "After it is over I shall have a barrel of beer brought into the yard ["Hear, hear," shouted the men]; "but I shan't tap it unless Mr. Wortley, the tory candidate gets in."

Machinists' and Engineers' Supplies.

NEW YORK, July 1, 1880.

The supply market continues much the same as reported last week. There are indications of a much better feeling, and confidence seems to be remarkably strengthened.

Wrought iron pipe is stiffer and the discount is quoted at 60@65% list for gas and steam pipe, and 20% on oil well casing and tubing.

At a recent meeting of the manufacturers of Copper Rivets and Burrs, the discount was changed to 45 per cent., the list remaing as heretofore.

The following announcement has been made:

Office of the NICHOLSON FILE Co., PROVIDENCE, July 1, 1880.

Until futher notice, the following will be our factory prices:

	Dis. per cent.
Nicholson Files	30
Royal Mill Files, above 3-inch	40
Royal Files, all other kinds	50
Tools and Specialties	Net.

All discounts and prices have reference to our list of July 1, 1879, in which will be found our terms. All former quotations are hereby cancelled.

Respectfully yours,
W. T. NICHOLSON, President.

Steel-face sledges and hammers are quoted at 30% from list prices; Solid steel do. at 35%; Nuts, 7¼c. per pound off; Washers, 6¾c. per pound off; Machine bolts, 60% discount.

Coes' Genuine Screw Wrenches are sold by the trade at 50% discount from list. L. Coes & Co.'s "Mechanics' Wrenches" are sold at 10% less than "Genuine."

Babcock & Wilcox, 30 Courtlandt St., N. Y., have recently issued a fourth and revised edition of their publication entitled "Useful Information Pertaining to the Use of Steam," combined with their catalogue. This publication contains forty pages, and is a valuable work of reference. The matter is practical, and much of it has never been published in any other way. This catalogue is also accompanied by a business card, in the form of a pamphlet, which contains four pages of printed matter and references. The inside of the stiff covers are to be used for memoranda, while the outside bears the business card of the concern mentioned. The design is a beautifully executed steel plate engraving, and has a very neat and tasty appearance.

The Consolidated Safety Valve Co., Boston, inform us that they are over crowded with orders, but are making additions to their manufacturing capacity, which will soon enable them to meet the requirements of their customers.

Iron Review.

NEW YORK, July 1, 1880.

A feeling of dullness still prevails in the iron market though there is more confidence expressed in the future. There is a heavy consumption but even a larger production of pig iron. Some furnaces are blowing out. We quote No. 1, $23; No. 2, $22, and grey forge, $22.

Manufactured iron is selling fairly at prices which are expected to advance by fall.

Pierson & Co., 24 Broadway, N. Y., under date of June 24, 1880, quote prices out of store as follows:

Iron Rails, $50 to $57, according to weight; Fish Plates, 2¾c. per lb.; Railway Spikes, 3c.; Bolts and Nuts, 3½c.; Common Bar Iron, 2.4c., basis from store; Refined do. 2.6c., basis; Ulster, 3 6-10c. basis; Machinery Steel, 6½c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 6¾c.; Sheet Iron, 3½c., basis; Angle Iron, 3¼c.; Tee Iron, 3¾c.; Band Iron, 3.4c.; Hoop Iron, 3.6c., and up according to size; Horse Shoe Iron, 3.3c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Makers' Supplies as follows:

Flange, 4½c.; C. H. No. 1 Shell, 3½c.; Tank, 3c.; C. No. 1, 3¼c.; Boiler Tubes, 50% discount from list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of July 1st, 1880:

A very strong feeling pervades the metal market, and a fair jobbing business is being carried on. Pig Tin very strong; stocks reduced and concentrated. London, £86 for Straits; Singapore, $26½. Would quote this market nominal. Banca Tin 22c.; Malacca and Straits, 19c.; Australian, Billton and English Refined, 18½c. to 18¾c.; Lamb and Flag 19¼c.; Pig Lead 5½c. to 5¼c.; Antimony, Cookson, 19c.; Hallett, 17c.; Domestic Spelter, 5½c.; Silesian, 6c.; Ingot Copper 19½c.; Nickel, $1.25; Solder No. 1, 10½c.; "half-and-half" 12½c.

WANTED.

Wanted, experienced machinists—steady work—good pay. David W. Pond, Worcester, Mass.

Wanted—Experienced and competent foreman to take charge of about fifty men, engaged mostly on mill machinery work. Address, with references, John T. Noye & Sons, Buffalo, N. Y.

Wanted—By an experienced man, situation as Superintendent or Manager of a General Jobbing Foundry and Machine Works. The West preferred. Address Box 86, Toledo, O.

Wanted.—First class second-hand Pulley Lathe, swing 5½ to 6 feet, turn 4 feet. Send cost and maker's name to Lock Box 2151, Denver, Col.

An experienced machinery iron works Superintendent wishes to engage with reliable parties. Address, P. H. L. care AMERICAN MACHINIST office.

FOR SALE.

A Works completely equipped for the manufacturing of carriage axles; is well located in relation to Coal and Iron, also very accessible to market. Address

E. P. BULLARD,
14 Dey Street, New York.

Mechanical Books.

Send 10 cents for 96 page Catalogue of Books for Machinists and Engineers.

D. VAN NOSTRAND,
23 Murray & 27 Warren Sts., New York.

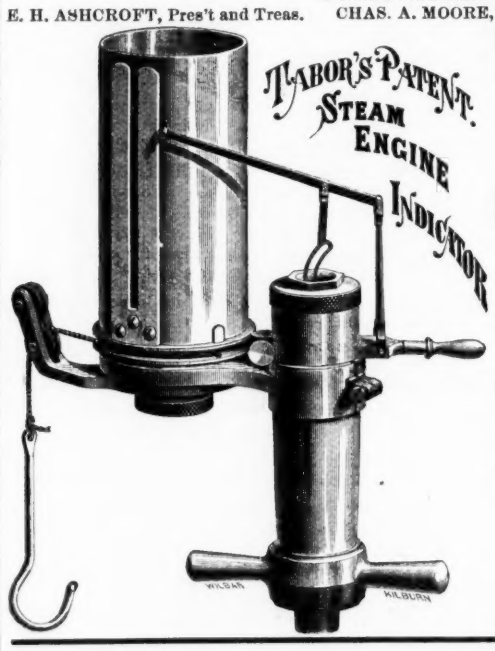
Drawing Instruments

AND MATERIAL, PAPER, &C.

G. S. WOOLMAN,
116 Fulton Street, New York.
Fully priced and illustrated Catalogues.

ESTABLISHED 1851.

E. H. ASHCROFT, Pres't and Treas. CHAS. A. MOORE, Gen. Manager. MARTIN LUSCOMB, Clerk



The Ashcroft Manufacturing Co.

Successors to E. H. ASHCROFT,
"Original Steam Gauge Works."
THE E. H. ASHCROFT
Improved "Bourdon" Steam Gauges,
Sole Owners and Manufacturers of
TABOR'S PATENT
STEAM ENGINE INDICATORS,
Specially adapted to
Indicating High Speed Engines & Locomotives
STEAM AND WATER GAUGES,
Railway, Steamship & Machinery Supplies
WAREROOMS:
Nos. 51 & 53 Sudbury St., and
8, 10, 11, 12 & 14 Bowker Street,
BOSTON, MASS.
Factories, BOSTON and LYNN.

THE BEST IN THE WORLD.

HALL'S PATENT
Compound Lever Cutting Nippers.

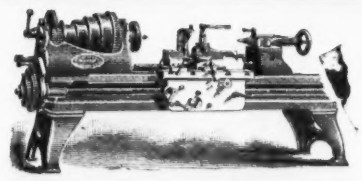
Every pair Warranted to Cut Steel Wire.

Worn or Damaged Parts can be replaced at a trifling cost.

Manufactured ENTIRELY OF STEEL by

THE INTERCHANGEABLE TOOL COMPANY,
A. GUSTAM, General Agent, 32 Howard St., N. Y.

For sale by all dealers in Machinists' Tools and Hardware. Send for Price List.



New Haven Manf'g Co.
NEW HAVEN, CONN.
Iron-Working Machinery,
PLANERS, SHAPERS, DRILLS.

The Workshop Companion.

A handy and useful book of practical information for **Engineers, Machinists, Draughtsmen and Mechanics,** containing useful and reliable recipes, rules, processes, methods, practical hints, &c. **NO** medical or cookery recipes. 164 pages. This book will be sent, post-paid, on receipt of Twelve 3-cent postage stamps.

T. P. PEMBERTON,
5 Dey Street, Room 13, New York.

RICHARD DUDGEON,
24 Columbia Street.
NEW YORK,
Maker and Patentee of
IMPROVED HYDRAULIC JACKS,

Punches, and Roller Tube Expanders,
AND
DIRECT ACTING
Steam Hammers.

Communications by letter will receive prompt attention.

Jacks for Pressing on Car Wheels or Crank Pins made to order.

NICHOLSON FILE CO.

SOLE MANUFACTURERS OF

FILES AND RASPS

HAVING THE INCREMENT CUT.

Also, FILERS' TOOLS and SPECIALTIES.

"Nicholson File Co's" Files and Rasps.
"Double Ender" Saw Files.
"Slim" Saw Files.
"Racer" Horse Rasps.
Handled Rifflers.
Machinists' Scrapers.
File Brushes, File Cards.
Surface File Holders.
Vice File Holders.
Stub Files and Holders.
Improved Butchers' Steels.

Manufactory and Offices at **PROVIDENCE, R. I., U. S. A.**

NEWARK STEEL WORKS.

BENJAMIN ATHA & CO.

MANUFACTURERS OF

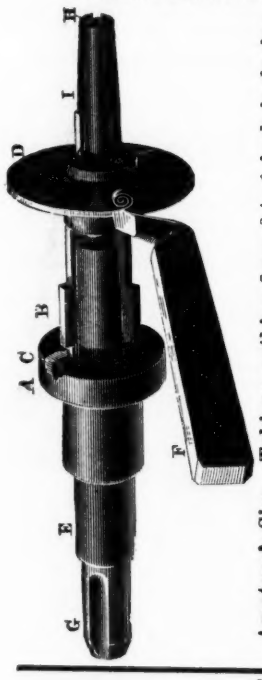
CAST STEEL

WE MAKE GRADES OF STEEL SPECIALLY ADAPTED TO THE MANUFACTURE OF LATHE TOOLS, CHISELS, TAPS & DIES

BENJ. ATHA. NEWARK, NEW JERSEY. J. ILLINGWORTH.

Le COUNT'S
New Expanding Mandrel

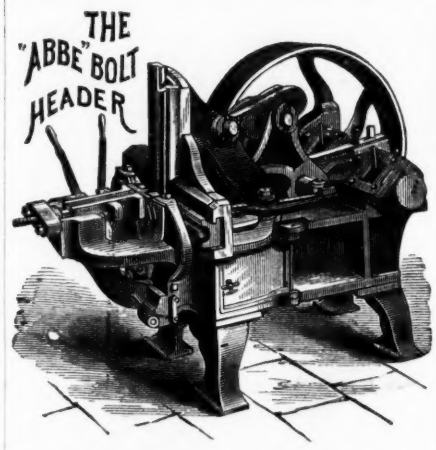
PATENTED DECEMBER 25, 1877.



Amateur's Size. Taking anything from ⅜ to 1 inch inclusive.
PRICE $5.00.
This Tool is Steel, well made, is Simple, Substantial, Cheap and Useful.

MANUFACTURED BY
C. W. Le COUNT,
South Norwalk, - - - - - Connecticut.

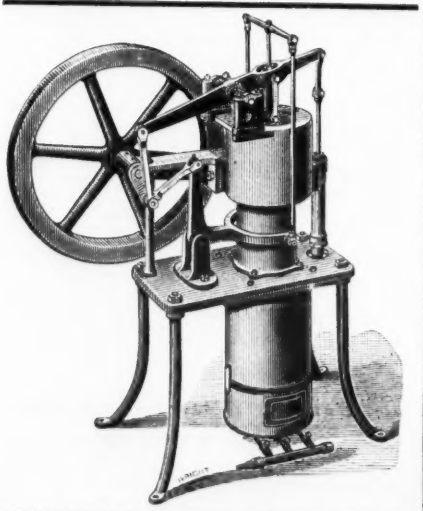
BOLT FORGING MACHINES.



Power Hammers, Machinists', Blacksmiths' Tools and Wood-Working Machinery a Specialty.

S. C. FORSAITH & CO.,

MANCHESTER, N. H.



ERICSSON'S NEW PATENT CALORIC PUMPING ENGINE is specially intended for domestic use in lifting and forcing water from wells and cisterns, or from Croton pipes, to tanks on upper floors of buildings in city or country.

This pumping engine is entirely safe, no steam being employed, and is not liable to derangement.

All kinds of fuel will answer for this engine, but coal-gas is preferable, the consumption being only 15 cubic feet per hour. Besides gas is handier and cleaner than coal or other combustibles. Servant girl can operate it!

Price for 8-inch cylinder, pumping 350 gallons per hour 50 feet: With gas furnace, - $260 00
With coal furnace, - 275 00
Price for 6-inch cylinder, pumping 200 gallons per hour 50 feet: With gas furnace, - $210 00
With coal furnace, - 220 00

Manufactured by the Delamater Iron Works.
C. H. DELAMATER & CO., Proprietors,
No. 10 CORTLANDT ST., N. Y. CITY.

W. BARNET LeVAN,

Mechanical & Consulting Engineer,
3607 Baring St., Philadelphia, Pa.

CHAS. G. LUNDELL,

No. 7 Exchange Place,

BOSTON,

MASS.

SWEDISH IRON

REPRESENTING

EKMAN & CO.

GOTHENBURG,

SWEDEN.

POOLE & HUNT, BALTIMORE.

MANUFACTURERS OF

THE POOLE & HUNT LEFFEL TURBINE

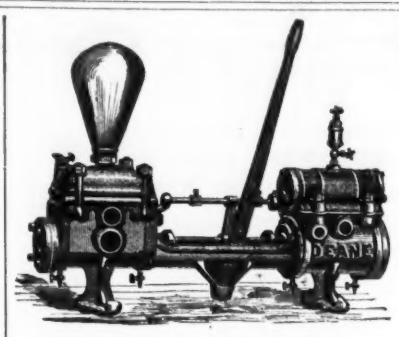
WATER WHEELS,

MACHINE MOULDED MILL GEARING.

SHAFTING, PULLEYS AND HANGERS.

STEAM ENGINES AND BOILERS.

MIXERS FOR FERTILIZERS AND CHEMICALS.



SIMPLE! POSITIVE! DURABLE!

For Every Possible Duty.

The Best STEAM PUMP in America.

"The Deane."

SEND FOR ILLUSTRATED CATALOGUE AND PRICE LIST.

DEANE STEAM PUMP CO.

OFFICE AND WORKS:
HOLYOKE, MASS.

WAREHOUSE:
92 and 94 LIBERTY ST.,
NEW YORK CITY.

J. H. HARRIS, Manager.

Branch Office,
46 & 48 WEST LAKE STREET, CHICAGO, ILL.

BRADLEY'S CUSHIONED HELVE HAMMER.

Awarded first premium, Silver Medal at American Institute Fair, 1873, Cincinnati Industrial Exposition, 1874, and the Diploma of Honor and Grand Medal of Merit at the Centennial Exhibition, in 1876,

Being the highest award given any goods of their class in America or Europe.

IT HAS MORE GOOD POINTS, LESS COMPLICATION,
MORE ADAPTABILITY, LARGER CAPACITY,
DOES MORE AND BETTER WORK, TAKES LESS POWER,
COSTS LESS FOR REPAIRS
THAN ANY HAMMER IN THE WORLD.

Guaranteed as represented. (Established 1832.)

BRADLEY & COMPANY, Syracuse, N. Y.

The E. HORTON & SON CO.

Prices Reduced.

Windsor Locks, Conn.

MANUFACTURERS OF

THE HORTON LATHE CHUCK,

BOTH

INDEPENDENT AND UNIVERSAL,

ALSO THE

Horton Car Wheel Chuck.

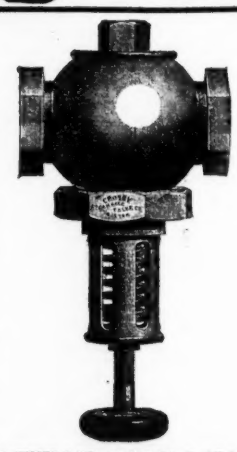
FEBRUARY 1st, 1880.

From this date a discount of 25 per cent. will be made from the list price of The Horton Lathe Chuck,

Soliciting your orders, we are, respectfully yours,

Send for Price List. THE E. HORTON & SON CO.

Crosby's Self-Regulating



Reducing Valve.

CROSBY STEAM GAGE & VALVE CO.

J. H. MILLETT, Pres't.
GEO. H. CROSBY, Sup't. GEO. H. EAGER, Treas.

Sole Proprietors and Manufacturers of

CROSBY'S

Adjustable "Pop" Safety Valve.
Self-Regulating Reducing Valve.
Improved Steam Pressure Gage.
Self-Closing Water Gage.
Improved Steam Engine Indicator.

Sole Manufacturers and General Agents for
The "VICTORY" Steam Cylinder Lubricator.
And all instruments of this class. Send for Illustrated Catalogue.

Cor. Milk & Batterymarch Sts., Boston.

The Raymond Mfg. Co.'s

PATENT

Non-Conductor Coverings for

STEAM PIPES AND BOILERS.

Standard Sectional Air-Space Covering.

Patented Jan. and April, 1870, and Sept., 1877.

American Ash Felting.

Patented March 24, 1874, and July 26, 1875.

Awarded Medal and Diploma at Centennial Exposition.

CEMENT FELTING AND RUSSIA HAIR FELT.

FACTORY: 642 W. 52d Street, | OFFICE: 108 Liberty Street,

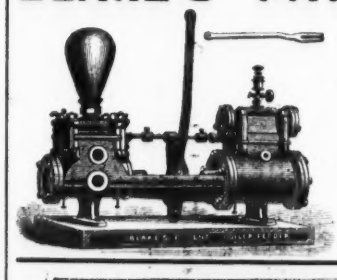
Send for Circulars. | NEW YORK.

Send for Circular containing list of

Practical Articles

Contributed to the AMERICAN MACHINIST by 40 of the best writers.

BLAKE'S PATENT STEAM PUMPS.



MORE THAN 13,000 IN USE.

Adapted to Every Situation.

Send for New Illustrated Catalogue.

GEO. F. BLAKE MANF'G CO.

88 Liberty Street, NEW YORK. | *44 Washington St.,* BOSTON.

KEARNEY & FOOT

Office, No. 78 Chambers Street, N. Y. | **Full Weight Hand-Cut Files.** | Manufactory, PATERSON, N. J.

The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.

THE SINGER MANUFACTURING CO.

Messrs. KEARNEY & FOOT, Elizabethport, N. J., July 9th, 1877.

Dear Sirs:—We have for the past ten years used the Files of your manufacture, and during that time we have never had any fault to find with them. We can safely affirm that for evenness of temper, sharpness of cut, accuracy of shape and all other qualities which go to make up a perfect File, that they are equal, and in some respects superior, to the best English-made Files. Very Truly, WM. H. INSLEE, Contractor.

Messrs. KEARNEY & FOOT,

Gentlemen:—We have been using your Files, both new and re-cut, for several years, and take pleasure in saying that we have found them a very superior article.

HANS REISE, Contractor, with The Singer M'f'g Co.

We print instructions on the use of Files, and also give the diameters of round and square Files from 3 to 16 inches. They are on card board, 10x12 in., and are intended to be put up in the shop for the men to read. We are pleased to mail them to any manufacturer on receipt of the necessary 6 cents postage.

Respectfully, KEARNEY & FOOT.

Largest Establishment of the Kind in the World.

MOSS ENGRAVING CO.

J. C. MOSS, Pres't and Sup't. *Incorporated April 2, 1880.* J. E. RAMSEY, Secretary.
R. B. MOSS, Ass't Sup't.
M. A. MOSS, Treasurer. **MOSS' NEW PROCESS.** H. A. JACKSON, Ass't Sec'y.

535 PEARL STREET, COR. ELM, NEW YORK.

IMPORTANT TO MACHINERY MANUFACTURERS AND DEALERS.

Engraved Plates for Newspaper, Book and Catalogue Illustrations, &c., executed in Type Metal in a superior manner by a new and improved photo-chemical method, from all kinds of Prints, Pen Drawings, Photographs, Tin Types, Original Designs, Pencil Sketches, and, when available, from the object itself. *Much Cheaper than Woodcuts.* These plates are mounted type high, ready for use on any ordinary press, and are guaranteed to be fully equal to the best woodcuts. Electrotypes can be made from them in the usual manner. We also have a fully equipped steam electrotyping department. Engravings of **MACHINERY** of all kinds executed in the highest style of the art at reasonable prices. **Mr. Moss, in withdrawing from the Photo-Engraving Co., 67 Park Place, has retained for himself all improvements made and used by him in Photo-Engraving since May, 1872.** Our motto is, "The Best Work at Low Prices. Always on Time." Send stamp for illustrated circular. Send copy for estimate. Please mention this paper.

UNITED STATES METALLIC PACKING CO.

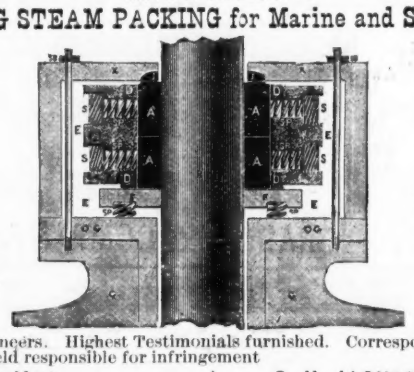
MANUFACTURERS OF

SELF-ADJUSTING STEAM PACKING for Marine and Stationary Engines.

PATENTED.

February 10th, 1863.
March 7th, 1871.
October 8th, 1872.
April 21st, 1874.

Other Patents Pending.



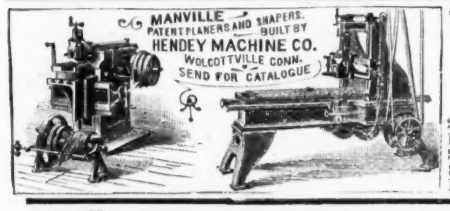
SECTIONAL VIEW.

A A—Packing Blocks.
C C—Ring enclosing Blocks
D D—Projections for Springs and Set Screws.
E E—Space for Vibration.
F F—Follower.
G G—Cylinder Head.
S S—Set Screws.
S B—Stud Bolts.
J—Ball Joint.
O G—Gland.
S P—Springs.
X X—Case.
R—Rod.
S—Set Screws.

Endorsed by leading engineers. Highest Testimonials furnished. Correspondence solicited. Makers, Sellers and Users will be held responsible for infringement

EDW. CUNNINGHAM, President.
JOSIAH A. OSGOOD, Superintendent, 85 Devonshire Street, Boston, Mass.

C. H. JACKSON, General Agent, 34 Coal & Iron Exchange, New York.

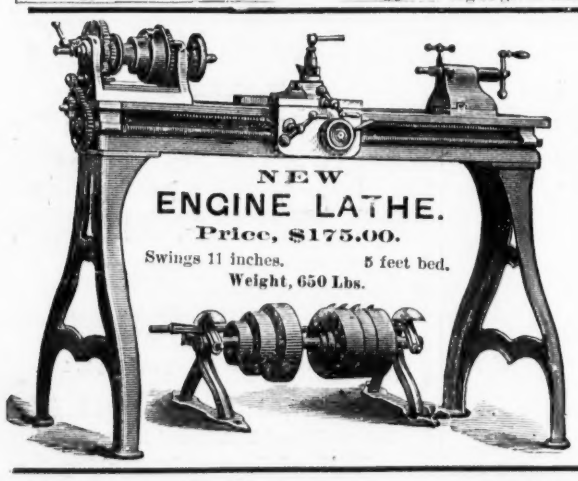


The Hendey Machine Co.

WOLCOTTVILLE, CONN., U. S. A.

Manville Patent Iron Planers and Shapers.

15 in. Shapers, 24 in. Shapers, 3½ ft. x 16 in., 5 ft. x 20 in., 6 ft. x 24 in., 8 ft. x 24 in. Planers, Amateurs' Hand Planers, with chuck and centers, Hollow Steel Spindle Hand Lathes, Brass and Wire Slitters, Spring Chuck, and Common Clock Lathes. Catalogue gives many names of users of our tools.



A. F. Prentice & Co.

Manufacturers of

Light Machinists' Tools.

Improved Upright Drills, with Lever Feed and Wheel Feed with Quick Return Motion.

Hand and Foot Power Lathes.

SLIDE RESTS.

Special Machinery and Machine Jobbing.

FOOT POWER LATHES A SPECIALTY.

54 Hermon Street.
WORCESTER, MASS

SAMUEL A. BECKETT, Mechanical Engineer. FREDERICK H. McDOWELL, Engineer of Mines.

Beckett & McDowell,

Formerly with Union Iron Works (PRESCOTT, SCOTT & CO.) of San Francisco, Cal.

MINING AND MECHANICAL ENGINEERS

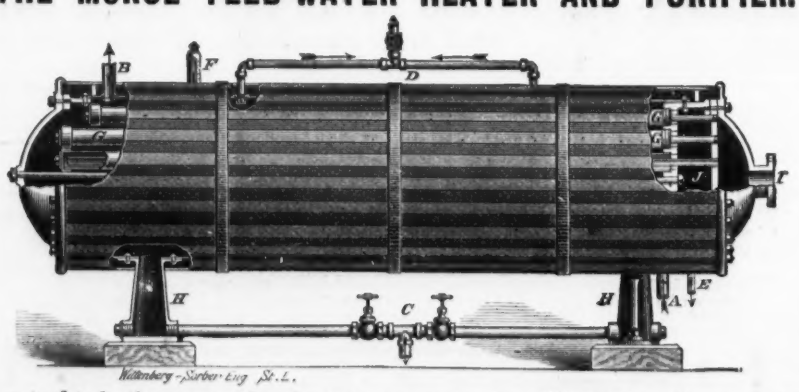
AND MANUFACTURERS OF

Steam Engines and Mining Machinery,

Office, 17 COURTLANDT ST., NEW YORK.

Works at Arlington, N. J.

THE MORSE FEED-WATER HEATER AND PURIFIER.



Guaranteed to be the most perfect device in the market for utilizing the exhaust of steam engines. For further particulars, address

E. L. MORSE, Mechanical Engineer, 313 Olive Street, St. Louis, Mo., or J. F. WANGLER, St. Louis Roller Works.

Address P. O. Box 2187. **PIERSON & CO.** Office, 24 Broadway, N.Y.

ESTABLISHED 1790.

IMPORTERS AND DEALERS IN

IRON and STEEL of every Description.

Warehouse, 24 & 26 Broadway, and 77 & 79 New Street.

PRICE LISTS FURNISHED ON APPLICATION.

H. PRENTISS AND COMPANY

Manufacturers of PATENT RELIEVED

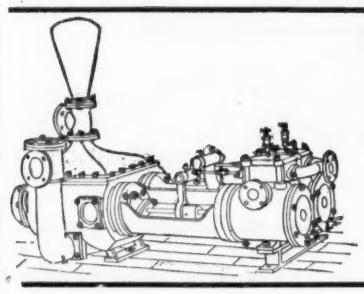
Machinists', Blacksmiths' and Gas Fitters'

Taps; Dies, Reamers and Screw Plates, &c., &c.

DEALERS IN MACHINISTS' SUPPLIES.

No. 14 DEY STREET, - NEW YORK.

Agents for The Billings & Spencer Co., Reynolds & Co.'s Screws, Deverall's Patent Oilers.



Worthington Steam Pumps,

For all purposes and of all Sizes.

PRICES BELOW THOSE OF ANY OTHER STEAM PUMP IN THE MARKET.

WATER METERS. OIL METERS.

THE WORTHINGTON PUMPING ENGINES FOR WATER WORKS.

Used in over 100 Water Works Stations.

HENRY R. WORTHINGTON,

239 Broadway, N. Y. 709 Market street, St. Louis,
83 Water street, Boston.

JAMES W. SEE, Consulting Engineer,

HAMILTON, OHIO.

Betts Machine Co.

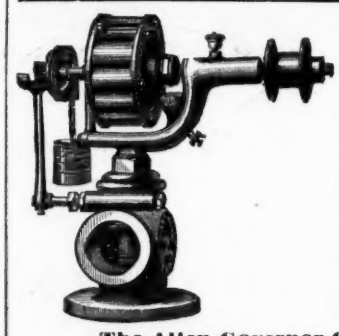
WILMINGTON, DEL.

Makers of

HEAVY MACHINISTS' TOOLS

of the various kinds for working Iron and Steel; Standard Gauges, Measuring Machines, &c., &c.

Send for Circulars and list of tools on hand for immediate delivery.



The only perfect Engine Governor in the World. Especially guaranteed to accurately govern variable cut-off Engines. Send for Circular and REDUCED Price-List.

The Allen Governor Co.

B. W. Spence, Treas. BOSTON, MASS.

Dead Stroke POWER HAMMERS

Are superior to all others for Forging and Die Work. Over 500 now in use.

Manufactured by

PHILIP S. JUSTICE,

14 N. 5th St., Philadelphia, Pa.

WILLIAM COOKE,

(Successor to COOKE & BEGGS,)

6 Cortlandt St., New York,

SELLING AGENT FOR

ROOTS' NEW IRON BLOWER.

POSITIVE BLAST.

IRON REVOLVERS, PERFECTLY BALANCED

IS SIMPLER, AND HAS

FEWER PARTS THAN ANY OTHER BLOWER.

ROOTS'

Blacksmith's Hand Blowers, Portable Forges, and Tuyeres.

SEND FOR PRICE LIST.

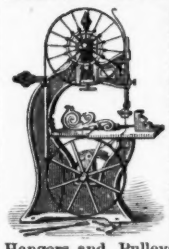
AITCHISON & DOOLITTLE SOLE MANUFACTS OF
STEAM FLUE CLEANER
CLEVELAND O
PAT JULY 15. 79
A & B SECTION VIEW
CIRCULARS ON APPLICATION
WOOD & DRAKE 71 RUTGERS ST. N.Y.
ACTS FOR N.Y. & N.J.

WOOD WORKING MACHINERY.

J. A. FAY & CO.,

BUILDERS OF

IMPROVED MACHINERY FOR WOOD CUTTING.

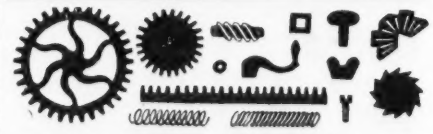


Numbering some 300 different Machines—Planing and Matching Machines, Surface Planing Machines, Molding and Tenoning Machines, Mortising and Boring Machines, Carving and Dovetailing Machines, Shafting and Friezing Machines, Horizontal and Vertical Boring Machines.

Improved Variety & Universal WOOD WORKERS.

Band, Scroll, Ripping and Cutting-off Saws, Band and Circular Resawing Machines, Spoke and Wheel Machinery, Shafting, Hangers and Pulleys, etc., etc. Original in design, simple in construction, perfect in workmanship, saves labor, economizes lumber, and its productions are of the highest standard of excellence. ***Send for Circulars and Prices.***

J. A. FAY & CO., Cincinnati, Ohio, U.S.A.



Small Tools of all kinds: GEAR WHEELS, parts of MODELS, and materials of all kinds. Catalogues free. GOODNOW & WIGHTMAN, 176 Wash'ton St., Boston, Mass.

E. E. GARVIN & CO.

Manufacturers of

Milling Machines, Drill Presses,

No. 4 Milling Machine.

Hand Lathes, Tapping Machines, Cutter Grinders and Wood Planers. Milling Cutters, all shapes and sizes. Gear Cutting and Milling in all its branches.

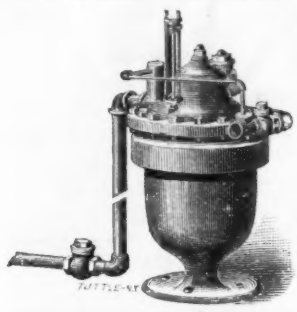
139-143 CENTRE ST.
Cornell's B'ld'g
NEW YORK.

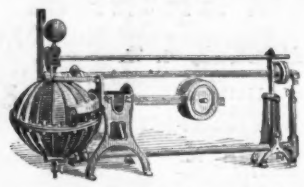
Send for illustrated Catalogue.

TOOLS for Machinists, Carpenters, Amateurs, Jewellers, Model Makers, Blacksmiths, etc. *Send for Catalogue*, and state *what kind* of Tools you require.

TALLMAN & McFADDEN,
607 Market St., Philadelphia, Pa.

THE ALBANY STEAM TRAP.

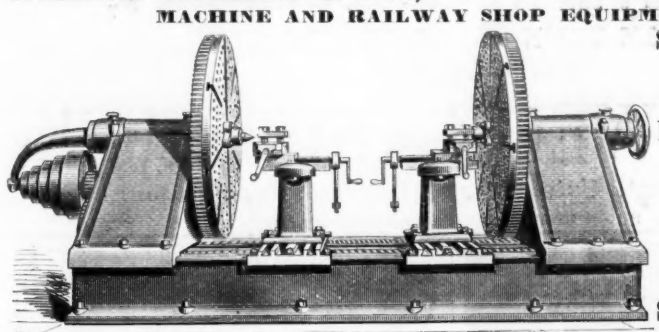




This Trap automatically drains the water of condensation from HEATING COILS, and returns the same to the Boiler, whether the coils are *above or below* the water level in Boiler, thus doing away with pumps and other mechanical devices for such purposes. Address

ALBANY STEAM TRAP CO.,
ALBANY, N. Y.

WILLIAM SELLERS & CO., - - - PHILADELPHIA.
MACHINE AND RAILWAY SHOP EQUIPMENTS.



Shafts, Couplings, Hangers, Pulleys, Mill Gearing, Etc. Lathes, Planers, Drills, Shapers, Bolt Cutters, Etc.

Railway Turntables and Pivot Bridges. Gifford Injectors, Sellers' Improvements.
NEW PATTERNS. SIMPLE, EFFECTIVE.
NEW YORK OFFICE, 79 LIBERTY STREET.

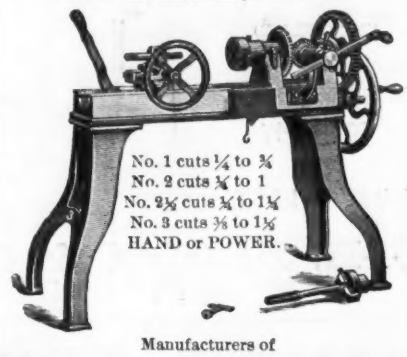
New Mechanical Movement.

Patented March 9th, 1880.

A POSITIVE AND PERFECTLY NOISELESS SUBSTITUTE FOR PAWL AND RATCHET.

Edward Wright & Co.
561 Main Street,
WORCESTER,
MASS.

BOYNTON & PLUMMER,
WORCESTER, MASS.



Manufacturers of
BOLT CUTTERS,
Upright and Horizontal Drills,
For Blacksmiths' and Carriage Makers' Use.
Illustrated Catalogue furnished on application.

P. BLAISDELL & CO.
MANUFACTURERS OF
Machinists' Tools,
Worcester, MASS.

Pattern and Brand Letters.
VANDERBURGH, WELLS & CO.
Printers' and Engravers' Warehouse,
Corner Fulton and Dutch Sts.,
NEW YORK:

Machinists' and Foundry SUPPLIES. | Twist Drills, TAPS & DIES, Calipers, &c. | Miners' Supplies Of every description.

T. B. BICKERTON & CO.
No. 12 South Fourth St.
PHILADELPHIA, Pa.

Steam Packing. Cotton Waste. | *Foundry Facings.* BRUSHES. | Gum and Leather BELTING, HOSE, Etc.

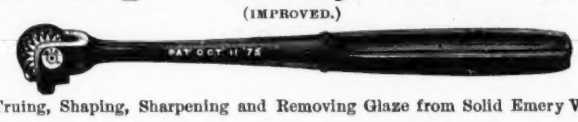
THE ONLY Exclusive Tool Store IN PHILADELPHIA. HEADQUARTERS FOR TOOLS of all DESCRIPTION.

Taps & Dies, Morse Twist Drills, Calipers, Dividers, Stubs Tools, Stubs Files, Stubs Steel, Grobet Files, Carvers, Gravers, Chucks, Speed Indicators, Vises, Hammers, Machine, Set & Cap Screws, &c., &c.

L. B. EATON,
TOOL STORE
11 N. 6th St.
PHILA.

The Huntington Emery Wheel Dresser.
(IMPROVED.)

Invaluable to Users of Emery Wheels.



Thousands in Successful Use.

For Truing, Shaping, Sharpening and Removing Glaze from Solid Emery Wheels.

Price $4.00. Send for Circular. **C. E. ROBERTS & CO., CHICAGO, ILL.**

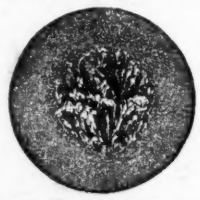
Steam Pumps,
AIR COMPRESSORS,
Friction Hoisting Engines,
Vacuum Pumps & Condensers,
GENERAL MACHINERY
Steam Engines.

Capacity to bore Cylinders 110 Inches Diameter. and turn Fly Wheels of 24 feet.

THE NORWALK IRON WORKS CO.
South Norwalk, Conn.

F. W. MOSS,
80 John Street, New York,
(Successor to Joshua Moss and Gamble Bros.,)
Steel and Files,
HAMMERS, ANVILS, VISES AND BLACKSMITHS' TOOLS.
WARRANTED CAST STEEL,
Specially adapted for Dies, Punches, Turning Tools, Drills, &c. Also

IMPROVED MILD-CENTRED CAST STEEL



For Taps, Reamers, Milling Tools, &c.

Warranted not to crack in hardening Tools of any Size.

The Goulds Manufacturing Co.

Manufacturers of all kinds of
Force and Lift PUMPS
For Cisterns, Wells, Railroads, Steamboats, Windmills, etc.
FIRE ENGINES, Hydraulic Rams, **AMALGAM BELLS** For Churches, Schools, and Plantations.
Corn-Shellers, Sinks, etc
Pumps and Materials for Driven Wells a specialty
Satisfaction guaranteed.
Catalogues furnished upon application.
INQUIRE FOR GOULDS PUMPS
FACTORY, SENECA FALLS, N. Y.
WAREHOUSE, 15 PARK PLACE, NEW YORK CITY

WILEY & RUSSELL MF'G CO.
GREENFIELD, MASS.
Lightning Screw Cutting Machinery and Tools.

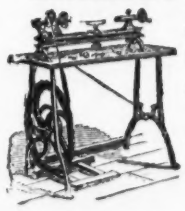
SEND FOR ILLUSTRATED PRICE LIST.

KATZENSTEIN'S Self-Acting Metal Packing,
For Piston Rods, Valve Stems, &c.
of every description,
For Steam Engines, Locomotives, Pumps, &c., &c.
Adopted and in use by the principal Iron Works, Engine Builders and Steamship Companies within the last eight years in this and foreign countries.
For full particulars and references address
L. KATZENSTEIN & CO.,
35 Desbrosses St., New York.

Monitor Binders FOR THE **American Machinist,**

$1 00 EACH BY MAIL OR EXPRESS.

FRASSE & COMPANY,
62 Chatham Street New York,
PROPRIETORS OF THE
Briggs, & Leader, Lathes,
SOLE AGENTS FOR
ELTERICH'S TAPS AND DIES,



Comprising the best assortment and largest variety, of threads, from 1-16 to ¼ inch in the United States.
Send for circular.
Importers of STUBS' TOOLS, FILES, and STEEL WIRE, and GROBET FILES.
Agents for the U. S. of Rollason's Patent Steel Music Wire.
No. 0 to No. 32 (Music Wire Gauge) always in Stock.

Sole Agents for Chateau's French Emery Paper.

Fine Tools, Files, Steel Wire,
Silver Solder for Brazing Band Saws,
AND SUPPLIES FOR MACHINISTS A SPECIALTY.

IMPROVED
Anti-Incrustation Liquid,
For the Prevention and Removal of
SCALE IN STEAM BOILERS.

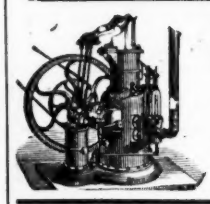
Is purely a liquid, free from sediment, contains no acid, and is absolutely safe and effective.

Prof. H G. Torrey, of the U. S. Assay Office, says: "Downer's Improved Boiler Liquid is free from all injurious substances, and well adapted to accomplish the object sought; know of nothing better and highly recommend it."

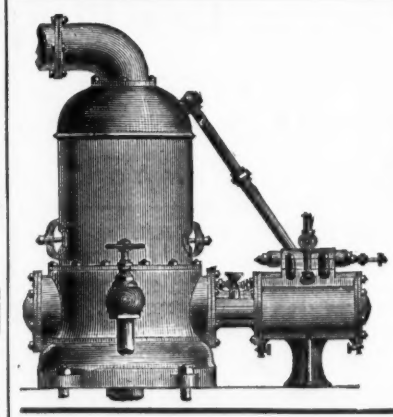
Circulars and references on application.

A. H. DOWNER,
PROPRIETOR AND SOLE MANUFACTURER,
17 Peck Slip, - New York.

AIR ENGINES. NO WATER. NO ENGINEER.



No Extra Insurance! Absolutely Safe! Simple! Reliable! Durable!
Most Convenient and Economical Power Known.
SHERRILL ROPER AIR ENGINE CO.
Manufacturers of Air Engines, Elevators and Hoisting Machinery,
91 & 93 Washington St., New York.



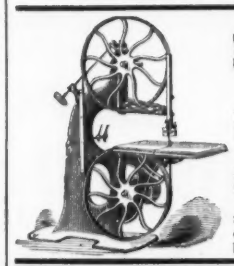
20 Per Cent. Saving in Fuel,
25 Per Cent. Increased Power,
BY ATTACHING
HAMILTON'S INDEPENDENT AIR PUMP
AND CONDENSER
TO YOUR ENGINE.
Manufactured only by
SAWTELLE & JUDD,
HARTFORD, CONN.

WHITTIER MACHINE CO.
MANUFACTURERS OF
STEEL BOILERS,
Steam Engines and Elevators,
Boston, Mass.: Works, 1176 Tremont St.
N. Y. Office, 120 Broadway.

E. LYON & CO.
470 GRAND ST.
NEW YORK.
Sole Manufacturers of

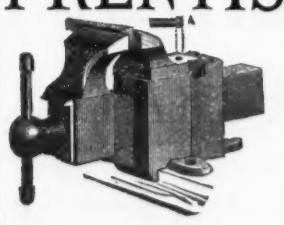
HYDRAULIC JACKS AND PUNCHES, HYDRAULIC PRESSES, HYDRAULIC PUMPS, POLISHING AND BUFFING MACHINERY.

Shears and Punches for Round, Square and Flat Irons



THE
Rollstone Machine Co.
FITCHBURG, MASS.
Rotary and Stationary Bed Planers, Wardwell's Patent Saw Benches,
Waymouth Lathes,
and large number of special machines.
We also carry a large stock of Second-Hand Machinery. Send for Catalogue.

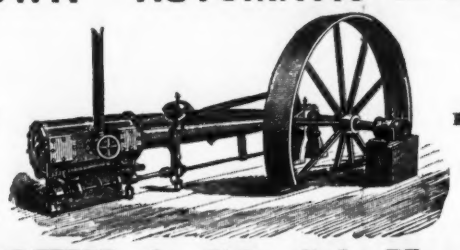
PRENTISS PATENT VISES,



ADJUSTABLE JAWS,
Stationary and Patent Swivel Bottoms,
Adapted to all kinds of Vise work.
HALL M'F'G CO., 23 DEY ST., NEW YORK.
SEND FOR CIRCULAR.

THE "BROWN" AUTOMATIC CUT-OFF ENGINE.

UNEXCELLED FOR WORKMANSHIP, ECONOMY AND DURABILITY.



WRITE FOR PRICES AND INFORMATION.

C. H. BROWN & CO., Sole Manufacturers,
FITCHBURG, MASS.

THE
LAWRENCE ENGINE,

A FIRST-CLASS AUTOMATIC CUT-OFF STATIONARY

ENGINE.

Highest Economy. *Best Workmanship at a Moderate Price.*

ARMINGTON & SIMS, - LAWRENCE, Mass.

JARVIS PATENT FURNACE
FOR SETTING STEAM BOILERS.

Economy of Fuel, with increased capacity of Steam Power.
The same principle as the SIEMENS' PROCESS OF MAKING STEEL, utilizes the waste gases with hot air on top of the fire.
Will burn all kinds of waste fuel without a blast, including screenings, wet peat, wet hops, sawdust, logwood chips, horse manure, &c.
Send for Circular.

A. F. UPTON, General Agent,
7 Oliver St., (P. O. Box 3401) Boston, Mass.

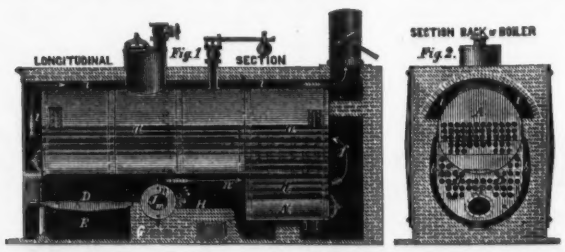
BARKER & BERTON, New York Agents, 422 East 23d St.

KORTING'S
UNIVERSAL INJECTOR,
A COMBINED PUMP AND BOILER FEEDER.
High or Low Pressure Steam. No Adjustment. Operated by One Handle. Send for Circular.
A. ALLER, 109 LIBERTY STREET, NEW YORK.

THE NASON MANUFACTURING CO.
DEALERS IN
Plain and Galvanized Wrought Iron Pipe,
AND MANUFACTURERS OF
STEAM AND GAS FITTINGS,
Steam Traps, Patent Vertical Tube Radiators, Steam and Hot Water Boilers, Steam Warming and Ventilating Apparatus, etc.
Nos. 71 Beekman and Fulton Streets, New York.

MONTGOMERY BOILER AND MACHINE WORKS.

WM. T. BATE & SON, East Conshohocken, PENNA.
MANUFACTURERS OF
Bate's Patent Steam Generator.



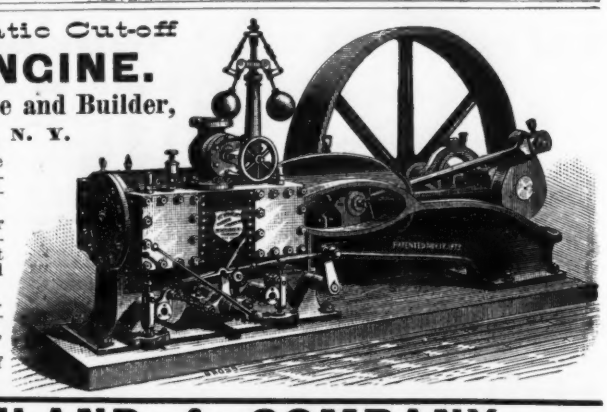
Iron Founders,
Boiler Makers AND Machinists.

A large number of these boilers in use in the best establishments and institutions, showing **Splendid Results** in the way of economy, efficiency, durability and convenience of cleaning. We refer to parties using. Write for particulars.

THE
HANCOCK INSPIRATOR CO.
MANUFACTURERS OF
INSPIRATORS, EJECTORS,
—AND—
GENERAL JET APPARATUS,
34 Beach Street, Boston, Mass.
35 Queen Victoria St., London, England.

Patent Automatic Cut-off
STEAM ENGINE.
Wm. Wright, Patentee and Builder,
NEWBURGH, N. Y.

The most economical in the use of fuel, the simplest in construction, and altogether the best cut-off engine in the market.
COMPOUND ENGINES for City Water Works; also for Manufacturing purposes, &c. (Highest duty guaranteed.) Marine and Stationary Engines.
STEAM BOILERS and TANKS. Light and Heavy Forgings, Shafting, Pulleys, Hangers, Mill Work, Iron and Brass Castings, &c.
A large general assortment of Patterns on hand.

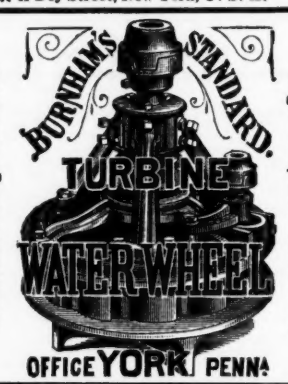


SWEETLAND & COMPANY,
No. 126 UNION ST., NEW HAVEN, CONN.
Sole Manufacturers of
THE SWEETLAND CHUCK,
Independent, Universal and Eccentric Combination.
PRICE LIST FURNISHED ON APPLICATION.

PORTABLE AND STATIONARY
Engines and Boilers,
2½ to 15 H. P. Return Flue Boiler, large Fire Box, no sparks. Do not fail to send for circular to
SKINNER & WOOD, Erie, Pa.

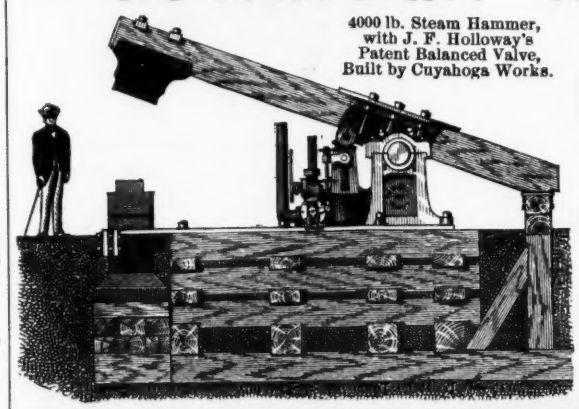
STEPHENS' PATENT PARALLEL VISE, with Swivel, Taper, Pipe and other attachments, is the handiest and most attractive in use, and is adapted to every variety of manufacture from Jewelers' to Locomotive Works. Twelve years constant use, ten hours each day, proves to us that a man cannot wear it out in a lifetime. Its parts are interchangeable. It opens **further**, holds **firmer**, is **heavier** and more **durable** than any other vise. Selected vises sent to any address by Express or C. O. D., with privilege of examining before taking. Write for illustrated circular. **Stephens' Patent Vise Co.**, 41 Dey Street, New York, U. S. A.

Over 1000 of these Turbines in operation in this and Foreign countries.



Tight shutting and easily operated gate. Large Pamphlet mailed free.

CUYAHOGA WORKS

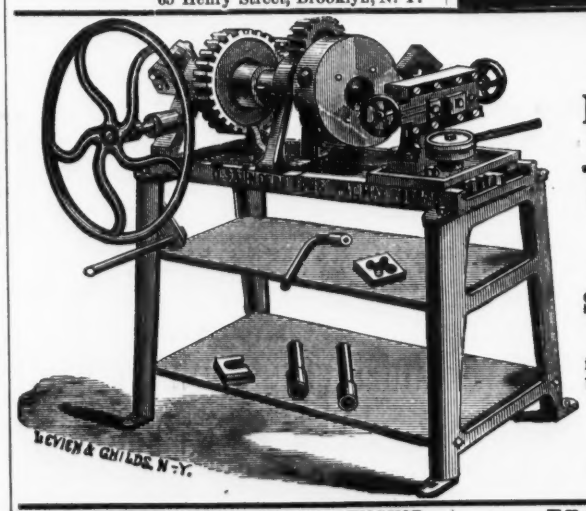


4000 lb. Steam Hammer, with J. F. Holloway's Patent Balanced Valve, Built by Cuyahoga Works.

Steam Hammers
LAND AND MARINE ENGINES
VERTICAL
Blowing Engines
For Blast Furnaces.
Cleveland, Ohio, U. S. A.

LATHE ATTACHMENTS
FOR MILLING
Plane and Irregular Forms.
Taps and Reamers Fluted and Gears cut without removing from the lathe centers.
See American Machinist, Sept. 13 and 20.
For circular address WM. MAIN,
65 Henry Street, Brooklyn, N. Y.

CHARLES MURRAY,
ENGRAVER ON WOOD.
No. 58 ANN ST.
NEW YORK.



D. SAUNDERS' SONS
New Pipe-Threading Machine
The I.X.L.
FOR HAND OR POWER.
Manufacturers of
Steam & Gas Fitters' Tools.
Pipe Cutting and Threading Machines for Pipe Mill Use, &c., a Specialty.
YONKERS, N. Y.
SEND FOR CIRCULARS.

THE ECONOMIZER STEAM ENGINE
Has no superiors. Comprises Simplicity, Durability and Economy. Send for catalogues. Also, a large stock of second-hand Steam Engines and Machinery.
S. L. HOLT & CO.
67 Sudbury St., Boston, Mass., U. S. A.

FRANK H. POND,
Consulting Engineer and Expert,
709 MARKET STREET,
ST. LOUIS, MO.

HORIZONTAL.
VERTICAL
Automatic Cut-off
ENGINES.
Yacht Engines,
Semi-Portable Engines.

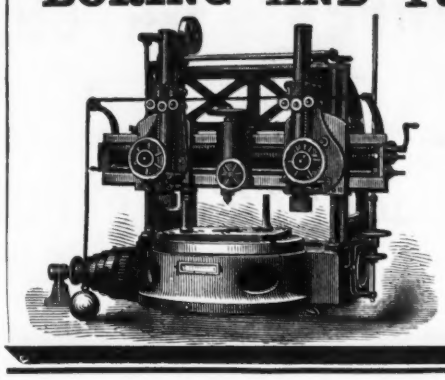
STEEL AND IRON BOILERS.

All sizes to 225 horse-power.

Send for pamphlet and say where you saw this.

FITCHBURG STEAM ENGINE CO.
Fitchburg, Mass.

BORING AND TURNING MILLS.



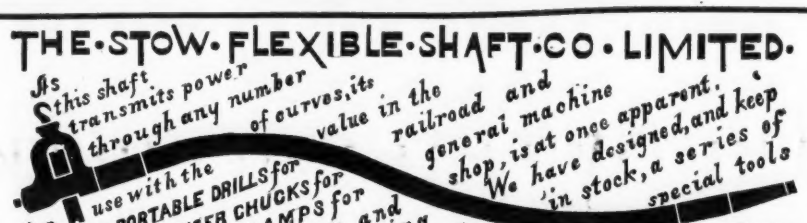
All Sizes: 4, 5, 6, 8, 10, and 12 feet Swings.

PATENTED IMPROVEMENTS.
New Patterns.

MACHINISTS' TOOLS,
The Latest and Best, at very moderate prices.

NILES TOOL WORKS,
HAMILTON, OHIO.

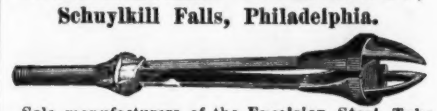
THE·STOW·FLEXIBLE·SHAFT·CO·LIMITED·


As this shaft transmits power through any number of curves, its value in the railroad and general machine shop, is at once apparent. We have designed, and keep in stock, a series of special tools for use with the shaft, as:-PORTABLE DRILLS for metals; AUGER CHUCKS for wood; CLAMPS for emery and buffing wheels, etc.

500·NORTH·FIFTEENTH·ST·PHILADELPHIA· CATALOGUE and PRICE LIST, on application.

TO STEAM USERS.
Save Fuel and Money.
Obtain regular speed, and prevent explosion by using
PEERLESS DAMPER REGULATOR,
the greatest fuel-saving appliance ever invented. Adjustable to any pressure. In ordering mention pressure. Illus. catalogue sent on application. We set it up and guarantee performance. Price, $75.00.
AMERICAN STEAM APPLIANCE CO.
SOLE MANUFACTURERS,
13 and 15 Park Row - - NEW YORK.

RUFFNER & DUNN,
Schuylkill Falls, Philadelphia.

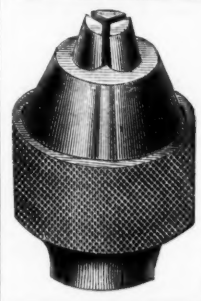


Sole manufacturers of the **Excelsior Steel Tube Cleaners.** Price, $1.00 per inch. Send for Circular containing names of users who consider it indispensable.

ENGRAVING ON WOOD
D. H. TUTTLE 5 BEEKMAN ST. N.Y.
Mechanical work a Specialty.

CARMICHAEL & EMMENS,
130, 132 & 134 Cedar Street, New York,
DEALERS IN
Iron and Steel Boiler Plate,
LAP WELDED BOILER TUBES, &c., &c.
Agent for Otis Celebrated Cast Steel Boiler Plates; the Coatesville Iron Co.; Pottstown Iron Co.; the Laurel Rolling Mills and Union Tube Works.
Wrought Iron Beams, Angles, Tees, Rivets, &c.

HEADQUARTERS
for every description of
MECHANICS' TOOLS.
A. J. WILKINSON & CO.
Illustrated Catalogue Free. BOSTON, MASS



ALMOND
DRILL
CHUCK
Made of Steel throughout, equal to doing any work required of it. Runs perfectly true.
For sale by all Machinists' Supply Stores.
T. R. ALMOND,
84 Pearl Street, Brooklyn, N. Y.

Improved Self-Regulating, Storm-Defying
WIND MILL.
The only Mill embracing all the recent improvements. Received Silver Medal at Paris Exposition in 1878. Five hundred in operation in the vicinity of New York. Every one warranted as to durability and quantity of water which can be pumped to any required height, from any location. The cost is small, compared with that of any other device now in use. Address, for Catalogues, **A. J. CORCORAN, 76 John St., New York.**

SECOND-HAND
AND
NEW TOOLS.
NEW LIST.

Miscellaneous Second-Hand Tools

All in Good Order, and will be sold very Low.

1 Engine Lathe 96 in. swing x 18 ft. Bed.
1 Engine Lathe 36 in. " x 15 ft. Bed.
1 Engine Lathe 36 in. " x 18 ft. bed.
1 Engine Lathe 17 in. " x 10 ft. "
7 Engine Lathes 18 in. " x 7½ ft. " (Chain Feed
1 Engine Lathe 24 in " x 8 feet Bed.
1 Engine Lathe 20 in. " x 6 "
1 Engine Lathe 20 in. " x 6 "
1 Shafting Lathe, 25 in. x 26 ft. bed.
5 Engine Lathes, 15 in. x 6 ft. bed.
1 Engine Lathe, 36 in. x 15 ft. bed.
1 Engine Lathe, 36 in. x 18 ft. bed.
1 Iron Planer, 24 in. x 4 ft.
1 Horizontal Boring Lathe.
2 Wood Turning Lathes.
1 Bement Double Pulley Lathe.
1 Shafting Lathe 22 in. " x 22 "
1 Speed Lathe.
1 Polishing Lathe 20 in. " x 25 "
1 Polishing Lathe 25 in. " x 22 "
1 Pulley Lathe, Double Head.
2 Spinning Lathes, " "
1 Iron Planer 60 in. x 60 in. x 30 feet.
1 Upright Drill 60 in.
1 Upright Drill 38 in.
1 Upright Drill 38 in.
1 Upright Drill 16 in.
1 Upright Drill 16 in.
1 Bench Drill.
1 Upright Boring Machine 78 in.
1 Pulley Polishing Machine.
1 Tool Grinder.
1 Pointing Screw Machine.
1 Daniels' Planing Machine.
One No. 2 Bolt Cutter.
One New "Hardaway" Bolt Heading Machine, to head up to ⅞-in. bolts.
A lot of Wood Working Machinery.
Six Small Punching Presses.
One N. Y. Safety Steam Power Co.
20 H. P. Upright Boiler with all connections, &c.

New Tools Very Low.

Five No. 2 Bolt Cutters, Wood & Light.
Please specify which of the above tools you want, and we will forward all particulars.

STEAM LAUNCH,

40 ft. x 7 ft.; draws 3 ft., Engine 5½ x 9; Boilers 32 x 48. Fitted with Carpets, &c., for pleasure.

A WOODRUFF & BEACH BEAM ENGINE,

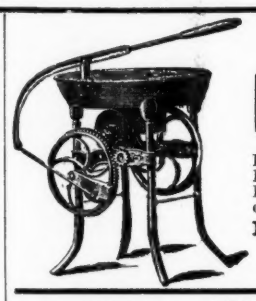
Low pressure, 42-in. cylinder, 84-in. stroke, with fly-wheel pulley, 20 ft. diameter, 36-in. face, and

FOUR TUBULAR BOILERS,

60 inches in diameter, 20 ft. long, and all connections practically as good as new.

For Sale by

The George Place Machinery Agency,
121 Chambers and 103 Reade St.,
NEW YORK.



EMPIRE FORGES
Improved. without Belts, Bellows, Crank Pins, Dead Centers or Back motion. Send for circular.
Empire Portable Forge Co.
COHOES, N. Y.

GEO. C. TRACY & CO
Counselors at Patent Law
EUCLID AVE. BLOCK,
CLEVELAND, O.
Before doing anything in regard to Patents, send for our 140 page book, **"ALL ABOUT PATENTS,"** mailed free.

SECOND-HAND AND NEW
Machinists' Tools.
JUNE 26th.

One No. 1 Square Arbor Lathe, *new.* Am. T. & Mch. Co. make.
One Engine Lathe, 92 in. x 20 ft. Wilmoth.
One Engine Lathe, 90 in. x 20 ft. Ames. New.
One Engine Lathe, 30 in. x 20 ft Good order.
One Engine Lathe, 30 in. x 16 ft. Wheeler, new.
One " " 30 in. x 12 ft. Ames. New.
Two " " 20 in. x 8 ft. Pond.
One " " 18 in. x 10 ft. Harrington.
Six " " 16 in. x 6 ft. Ames. New.
Six " " 16 in. x 7 ft. Ames, new.
Six " " 16 in. x 8 ft. " "
Three " " 13 in. x 4 ft. Not Screw Cutting.
One Pulley Lathe, 20 in. x 6 ft.
One Hand Lathe, 18 in. x 4½ ft.
Two " " 20 in. x 8 ft.
Six " " 11 in. x 4½ ft. New Spencer.
Four " " 7 in. x 2½ ft. " "
One Planer, 26 in. x 7 ft. New Haven. New.
One " 20 in. x 4 ft. Lathe & Morse
One " 18 in. x 3 ft. Putnam.
One Gould Shaper, new. 10 in. stroke.
One Hendey Shaper, nearly new. 15 in. stroke.
One 2 Spindle Profiler. Wood & Light.
Two 2 Spindle Profilers. Jones & Lawson.
Two Brown & Sharp Universal Millers.
One Index Milling Machine. New. Heavy.
One No. 2 Hand Millers. Pratt & Whitney.
One No. 3 Garvin Milling Machine. New.
One Heavy Turret Head Machine.
One 22 in. Drill, Sliding Head. New.
One 20 in, " Prentiss, new.
One No. 0 4 Spindle Drill. Pratt & Whitney.
One Heavy Drilling and Chucking Machine.
One No. 2 3 " " Smith & Garvin.
One 1 Spindle Drill. Smith & Garvin.
One Gear Cutter.
Three Sensitive Drills, drills to 3-16 in. hole. New.
One Boiler Makers' Combined Punch and Shear. New
Six Newell Punch Presses.
One No. 3 Wilder Punch Press. Geared. New.
One No. 4 " " " Geared. New.
One No. 6 Wilder Shear. Geared, new.
One No. 3 Wilder Bar Iron Cutter. New.
One 10 H. P. Baxter Engine.
Seven Stephens' Vises. Also, Parker Vises.
Belting, Shafting and Miscellaneous Machinery.

We will also have ready to deliver in 30 days New Ames Mfg. Lathes as follows:
Two Engine Lathes, 22 in. x 10 ft.
Four " " 24 in. x 12 ft.
Six " " 28 in. x 14 ft.

E. P. BULLARD,
14 Dey Street, New York.

LANE & BODLEY CO.
CINCINNATI, O.
Manufacturers of Wilson's Patent Free Open Double Disk
LEVER VALVE,
for Steam or Water, from 1¼" to 6". This valve has peculiar merits as a throttle valve for steam engines, and is well adapted to the use of a Sawyer's Valve, in place of the butterfly. Send for our catalogue and price list.

Headquarters for Machinists' Tools and Supplies.
CHAMPLIN & SPENCER,
154 East Lake Street, - Chicago, Ill.
Sole agents for the "Tanite" Emery Wheels and Grinding Machinery. Dealers in Screw Cutting Lathes from $50 to $150, with foot power, Small Amateur Lathes, Taps and Dies, "Twist Drills," Machine Screws, "Grobet Swiss Files," Machine Bits, Stubs' Steel Wire, Brown & Sharpe Tools, Emery, Crocus and Composition, Rouge, Drop Forged Lathe, Clamp and Die Dogs, Chucks, Wrenches, Hand and Bench Vises, Iron Levels, Metal Saws, Pattern Letters, Pliers, Calipers, Slide Rests, Steel Rules, Micrometer Calipers, Speed Indicators, "Metallic Corrugated Packing" for steam, air, gas or water joints, Steeline for hardening purposes, Upright and Hand Drills, Belting and Packing, Walrus Wheels, "Monk's Moulders' Tools," &c., &c

THE DIXWELL IMPROVEMENTS
For working Engines with
SUPERHEATED STEAM
Will reduce the consumption of fuel in non-condensing engines working under conditions otherwise favorable to economy, to 2.5 lbs. of coal per I. H. P. per hour, and in condensing engines to 1.75 lbs. of coal per I H. P. per hour.
Prevent the waste from Cylinder Condensation, which, tests show, amounts in every engine running to from 20 to 40%.
We will test, free of charge, engines now running, and show parties desiring to examine the Improvements how much they can save.
GEO. H. BARRUS, Agent,
553 Shawmut Ave., Boston.
Send for Circular and Pamphlets.

SEND FOR PAMPHLET. THE FAR-FAMED **AMERICAN LUBRICATOR.** TEN THOUSAND IN USE.
AMERICAN LUBRICATOR CO.
DETROIT. MICH. U.S.A.

CLARK'S RUBBER WHEELS.

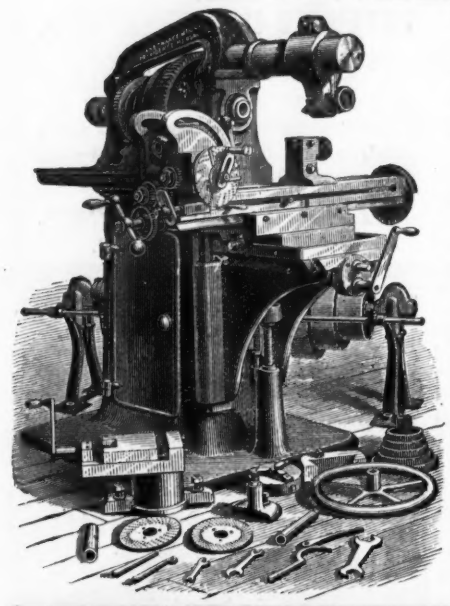
This wheel is the best now in the market, and is attracting the attention of large manufacturers on account of the great saving of floors, which is ten times greater than the extra cost of this wheel.
Adapted to all purposes, viz.. warehouse trucks, platform trucks, scales, boxes, baskets and heavy casters. For full particulars, address
GEO. P. CLARK, Windsor Locks, Conn.

WM. H. EDDY,
WORCESTER, MASS.
Manufacturer of
EDDY'S
TWIST DRILL GRINDING MACHINE,
Grinds Drills to the same shape as the best Machinists do by hand. No skilled workman needed to use it.
Refers to David W. Pond, Worcester, Mass.; N. B. Cushing, Jersey City, N. J.; W. H. Lewis; M. M. Kingland, N. J., and Hill, Clarke & Co., Boston, Mass. Write for prices and description.

STRONG'S PATENT
Feed Water Heater and Filter,
MANUFACTURED BY
I. P. MORRIS CO., - PHILADELPHIA.
SALES AGENTS:
KELLY & LUDWIG, 720 to 724 Filbert Street, Philadelphia.
CUMMINGS & GRAY, Cincinnati.
E. T. COPELAND, 30 Courtlandt Street, New York.
McAFEE, WHEELER & CO., 210 Spear St., San Francisco.
MORTON, REED & CO., Baltimore
FRANK H. POND, 709 Market St., St. Louis.
GRAY & EVERSON, Pittsburgh.

BROWN & SHARPE M'F'G CO.

PROVIDENCE, R. I.



MANUFACTURERS OF THE

UNIVERSAL

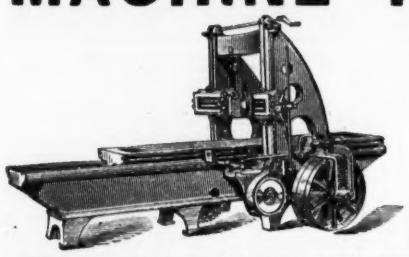
Milling Machine

This Machine has been designed especially to meet the wants of Steam Engine and Locomotive builders, and others engaged in the manufacture of heavy machinery and tools.

The essential features and motions are the same as in our smaller Universal Milling Machine, with such enlargement of the whole machine and its parts as would best adapt it for the class of work to be done. The cone has three diameters, each 3½ inches face. In addition, the cone is strongly geared, thus making six changes of speed. There are, also, the same number of changes of feed. The spindle boxes are of hardened cast steel, and, together with the spindle bearings, are carefully ground, and are provided with means of compensation for wear. The spindle will carry a cutter arbor projecting 15 inches, which is supported by an adjustable center at the outer end. Cutters of 8 inches or less diameter can be used. The horizontal movement of the spiral clamp bed upon the knee, in a line with the spindle of the machine, is 6½ inches, and the vertical movement of the spiral bed centers below the spindle centers is 11 inches. The spiral bed can be set at angles of 35° each way from center line of spindle, and can be fed automatically 22 inches, taking also 22 inches between the centers, and will swing 11½ inches.

☞ Illustrated Catalogue sent per mail on application.

MACHINE TOOL WORKS,



FORMERLY

FERRIS & MILES,

Twenty-fourth and Wood Streets

(Take Arch or Vine Street Car),

FRED'K B. MILES, Engineer. PHILADELPHIA

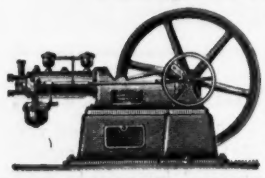
MACHINE TOOLS, STEAM HAMMERS, &c.

Having introduced many novel and valuable improvements into the construction of **SHAPING, SLOTTING, BORING and PLANING MACHINES**, as well as **Lathes and Drills**, we are now prepared to furnish these machines in greater perfection than ever before. By means of our improved devices the operations of turning, drilling, boring, planing and shaping, or slotting, can all be performed with a great saving of time and labor. It will be found worth any purchaser's while to examine our new methods of screw-cutting, feed-gearing and convenient arrangements and attachments for enabling work to be done with the least possible expenditure. We would direct special attention to our new **4 FT. RADIAL DRILL**, with **6 Automatic Feeds, 10 IN. STROKE SHAPING MACHINES, 17 IN. SQUARE PLANING MACHINES and PATENT SCREW CUTTING LATHES**, which cut 16 threads and give 16 feeds **without changing gears. Send for Catalogue.**

FRED'K B. MILES.

NEW OTTO SILENT GAS ENGINE.

Working without Boiler, Steam, Coal, Ashes or Attendance.



STARTED INSTANTLY BY A MATCH, IT GIVES FULL POWER IMMEDIATELY.

WHEN STOPPED, ALL EXPENSE CEASES.

No Explosions; No Fires nor Cinders; No Gauges; No Pumps; No Engineer or other attendant while running. Recommended by Insurance Companies.

UNSURPASSED IN EVERY RESPECT for Hoisting in Warehouses, Printing, Ventilating, Running small Shops, etc.

2, 4 and 7 H. P. and upwards. Built by

SCHLEICHER, SCHUMM & CO., 3045 Chestnut St., Philadelphia.

Boston Agency, HILL, CLARKE & CO., 36 & 38 Oliver Street.

COPE & MAXWELL M'F'G CO.

HAMILTON, OHIO., U. S. A.

New and Improved Patterns of

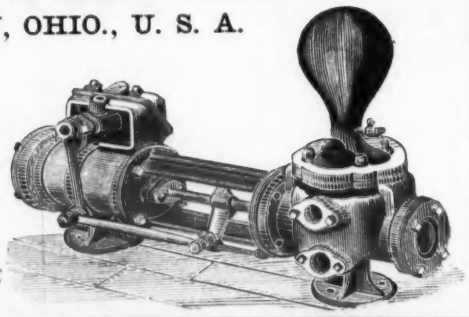
STEAM PUMPING MACHINERY,

FOR

Boiler Feeding, Water Works

and all general and special Pumping purposes.

Send for New Catalogue, illustrating every variety of Pumping Machinery.



Machines at reducad prices, and Wheels *Guaranteed.*

LEHIGH VALLEY EMERY WHEEL CO.

Send for our new Illustrated Catalogue

Weissport, Penn.

RECENTLY PUBLISHED.

WORKSHOP RECEIPTS

For the use of manufacturers, mechanics and scientific amateurs.

By ERNEST SPON.

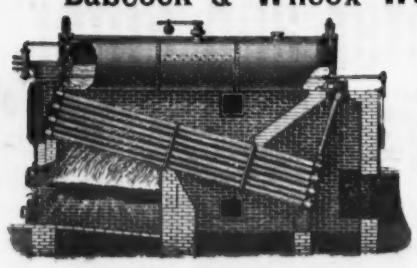
Crown, 8vo, illustrated. Price, $2.00. Send for Catalogue of books for practical engineers.

E. & F. N. Spon, 446 Broome St., N. Y.

JACK SCREWS, BOLTS, NUTS & WASHERS,

ALBERT BRIDGES. 46 Cortlandt Street, New York.

Babcock & Wilcox Water-Tube Steam Boiler,



Over 40,000 Horse-Power Now in Use. Adapted for all purposes. Safety from Explosions.

In sections easy of transportation. No bolted, screwed or packed joints. All joints made by expanding wrought iron tubes into bored holes. Can be erected or repaired by ordinary mechanic. Easily cleaned from soot or sediment. Adapted to all kinds of fuel. Steady water line and dry steam. No leaks from unequal expansion. Rapid steaming. Highest attainable economy. Centennial Exposition Medal awarded this boiler for highest economy and efficiency on test.

Illustrated Circulars and other desired information promptly furnished.

BABCOCK & WILCOX, Engineers, 30 Cortlandt St., New York.

THE PRATT & WHITNEY CO.

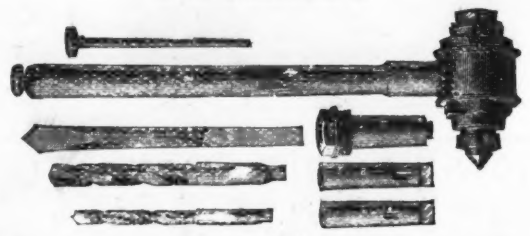
HARTFORD, CONN., U. S. A.

MANUFACTURERS OF

MACHINISTS' TOOLS,

FOR MACHINISTS, GUN & SEWING MACHINES.

MAKE SPECIALTIES OF



Renshaw Ratchet Drills,

CUSHMAN'S COMBINATION LATHE CHUCKS,

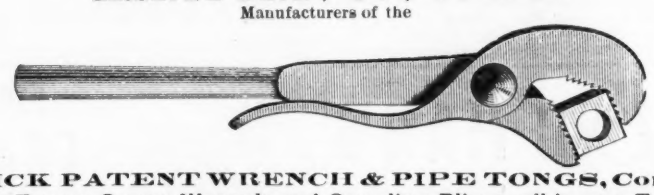
EXTERNAL AND INTERNAL CYLINDRICAL GAUGES.

Newell's Patent Planer Vise.

THE BILLINGS & SPENCER CO.

HARTFORD, CT., U. S. A.

Manufacturers of the



BARWICK PATENT WRENCH & PIPE TONGS, Combined.

Pipe Tongs, Screw Wrench and Coupling Pliers, all in one Tool.

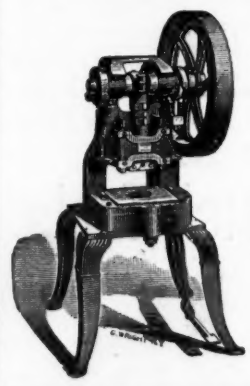
Will not crush a pipe. Adapted to any shaped object, round, square, flat or oval. Always ready for their work without altering or changing any of the parts. Drop Forged from best Norway Iron and Bar Steel.

PRICE LIST.

No. 0.	Nickel-plated, takes from No. 7 Wire to ⅛ inch Pipe	$2 00
" 1.	Finished and Polished, takes from Gas Burner to ¾ inch Pipe	2.50
" 2.	Ground and Finished takes from ½ inch to 1¼ inch Pipe	4.00
" 3.	" " " " 1 " 2 " "	5.00
" 4½.	" " " " 2 " 3½ " "	10.50

Steel and Iron Drop-forgings of every description for Guns, Pistols, Sewing Machines, Machinists' Tools and Machinery generally. Send for Illustrated Catalogue and Price List.

GOLD MEDAL AWARDED, PARIS EXPOSITION, 1878.



BLISS & WILLIAMS,

Plymouth, Pearl and John Streets,

BROOKLYN, N. Y.

Manufacturers of all kinds of

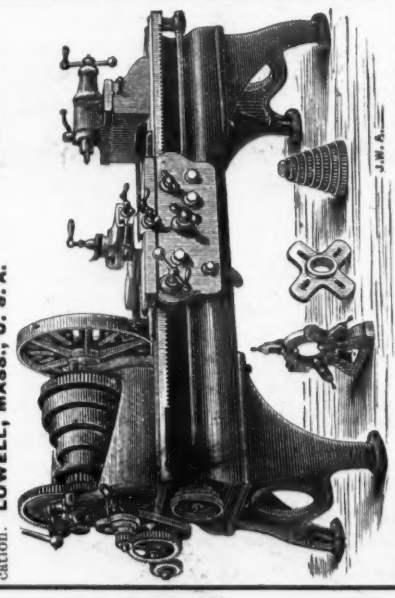
Presses, Dies and Special Machinery

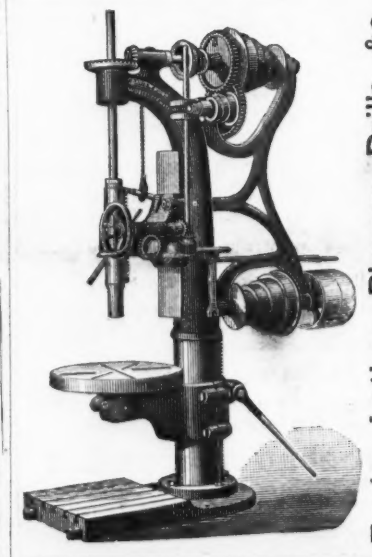
FOR WORKING SHEET METALS, &c.

FRUIT AND OTHER CAN TOOLS.

Iron Gears of all sizes and kinds made to order.
Brass Gears for Models, etc., on hand in large variety.
Geo. B. Grant, 100 Beverly St., BOSTON.
Send for circular.

GEO. W. FIFIELD, Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application. LOWELL, MASS., U. S. A.





Engine Lathes, Planers, Drills, &c.

DAVID W. POND, Worcester, Mass.

Send for Catalogue of New Designs.

AIR COMPRESSORS.

PRICES REDUCED. SEND FOR NEW CATALOGUE.

CLAYTON STEAM PUMP WORKS,

14 AND 16 WATER STREET, BROOKLYN, N.Y.

J.M.CARPENTER PAWTUCKET.R.I.

MANUFACTURER OF

TAPS, DIES.